*Background reading for the*

**Gilbert F. White National Flood Policy Forum**

***2010 Assembly***

# Managing Risk to Humans and to Floodplain Resources

**George Washington University**
**Washington, D.C.**

**March 9–10, 2010**

Hosted by the
**ASFPM Foundation**

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## About the Gilbert F. White National Flood Policy Forum

To facilitate national policy discussions on important floodplain management issues, the ASFPM Foundation sponsors an annual gathering of leading experts in the field of flood policy and floodplain management. These Forums will develop policy recommendations and establish an ongoing record of flood policy issues and directions for the future. The Forums have been named in honor of Gilbert F. White, the most influential floodplain management policy expert of the 20th century. The Forums are not only a tribute to his work, but also a recognition of the success of his deliberative approach to policy analysis and research.

Periodically, the Forum will explore one pressing national flood policy issue by facilitating a dialogue among about 80 topical experts, representing various stakeholders, including government, industry, and academia. The goal of each Forum will be to provide recommendations for policies that will reduce the human casualties and economic losses associated with flooding, as well as policies to protect and enhance the natural and beneficial functions of floodplains.

The discussions and recommendations for action and research formulated at each Forum will be summarized and distributed as a report by the ASFPM Foundation.

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# INTRODUCTION

The concept of managing flood risk is receiving increased attention from experts in the United States and throughout the world because it is expected to provide a more comprehensive approach to coping with unwanted impacts from flooding than any of our efforts to date. Past approaches (controlling flooding, regulating land use, managing floodplain resources, minimizing the vulnerability of property, and others) have met with some success. However, they often work at cross-purposes as a result of inconsistent or even contradictory policy foundations, are far from well-integrated as programs, have resulted in unintended consequences, focus only on the floodprone area itself rather than the entire watershed, and, taken together, have not reduced flood losses nationwide.

If properly structured, a risk management strategy would focus all the competing and complementary aspects of existing management approaches toward a common outcome. It would provide a framework for capturing, weighing, and addressing the hydrologic, hydraulic, economic, environmental, and demographic factors that affect the level of flood losses and resource degradation now and in the future. In addition, it should provide for the measurement of change in risk if added development occurs, populations increase, ecosystems collapse, infrastructure degrades, or the hazards change.

Use of a flood risk management strategy will mean moving away from our existing focus on the boundaries of anticipated flooding and toward more meaningful measures of the potential for flood losses and benefits across a geographic area. Because of this, such an approach will have broad implications for programs and policies at all levels and in activities ranging from mapping to planning to insurance to resource management to disaster response. Further, complex and nuanced flood risk management information will need to be synthesized into appropriate uses and messages that will foster the individual and collective behaviors that will best minimize adverse impacts from flooding and maximize the natural functions and resources of floodplains.

Although many experts are in favor of exploring the use of flood risk management, the disparate definitions, methods, approaches, and understandings at play ultimately will lead to confusion and ineffectual action by practitioners and policymakers alike unless strong direction is provided. Leading experts have been invited to the Third Assembly of the Gilbert F. White National Flood Policy Forum to consider what we would want to accomplish by embracing a flood risk management strategy, what our national goals should be for both flood risks and resources, how to get all entities onto the same platform for measuring and identifying risk, and the steps that would be needed to move such a strategy into being.

This 2010 Assembly of the Forum has been preceded by three preparatory gatherings.

- Symposium 1, “Defining and Measuring Flood Risk and Floodplain Resources,” was held in September 2009. Its participants agreed that “flood risk” is not confined to property damage or loss of life, but rather that the desired outcomes from a flood risk management strategy also should span societal and environmental concerns associated with flooding and with floodprone lands. They noted that flood risk, consequences, and impacts should be quantified on a watershed scale and also over time. Further, a suite of indicators is needed to reveal progress (or lack thereof) towards the management outcomes.

- The "Roundtable on the Natural Resources and Functions of Floodplains" was held in November 2009, and explored ways to integrate floodplain resource protection—which is critical to loss reduction and with ecosystem health—with existing and future strategies for floodplain management and flood risk management.
- Symposium 2, "Flood Risk Perception, Communication, and Behavior," also was held in November 2009. These experts were gathered to consider the human behavior and actions that are needed to reach flood risk management goals, and how those could be fostered with messages, incentives, standards, mandates, and other techniques.

## The 2010 Assembly

The challenge facing the third assembly of the Gilbert F. White National Flood Policy Forum is to solidify a cohesive vision of the fundamental components of a flood risk and resources management strategy for the nation, and to identify the steps that must be taken to develop and implement such a strategy.

Over 60 invited papers on this topic have been collected within this document, roughly grouped into five categories—although most papers adopted a broad perspective and could properly have been placed in more than one category. These background papers set out the thinking of experts in the field as they ponder whether a risk management approach will be an appropriate and more effective way to managing floods and floodplain resources in the future. If so, what would such a framework entail, what should it seek to achieve, what obstacles must be overcome? The thinking presented in these papers will underlie the discussion at the Assembly of the Forum.

**Part 1. Outcomes and Indicators: Recognizing Progress**

True progress in managing risks and resources cannot be made without an established direction and a destination. Where should we be going? How will we know what success looks like? What indicators will reveal whether progress is being made?

**Part 2. Communication: Human Behavior, Perception, Messages**

The trends in flood losses and resource degradation cannot be turned around unless there is a change in the actions taken by people, organizations, and governments. Why has this behavioral change not been forthcoming to date? How can we foster appropriate decisions and actions with regard to flood risks and water-related resources? What messages should be sent, and how?

**Part 3. Management Strategies: In Place and Envisioned**

Many communities, regional entities, and states have developed comprehensive strategies for managing flood risk or conserving floodplain resources, or both. Papers in this section describe some of those successes and also ask, What might an ideal approach look like?

**Part 4. Data and Tools for Managing Flood Risk and Floodplain Resources**

The management of risk and of ecosystems is a complex endeavor. However, we do have advanced technology, scientific understanding, and expertise on our side. What additional data would be needed to implement an effective risk-and-resources management strategy? What techniques, models, or approaches will work best?

**Part 5. National Policy and Programs: Ideas and Suggestions for Change**

Many approaches to flood loss reduction and resource protection have been institutionalized over the decades. Are overhauls needed in some areas? What adjustments could be made to existing programs to embrace risk management and resource protection and make more progress?

## 2010 ASSEMBLY OF THE
# GILBERT F. WHITE
# NATIONAL FLOOD POLICY FORUM
### "Managing Risk to Humans and to Floodplain Resources"
**Marvin Center, George Washington University**

# A G E N D A

## Tuesday, March 9, 2010

**1:00-1:45 pm** **Welcome and Introductions – 3rd floor amphitheatre**
*Scott Edelman, President, ASFPM Foundation; AECOM*
*Greg Main, Chair, ASFPM; Indiana State Floodplain Manager*
*Participants (brief self-introductions)*

**1:45-2:15 pm** **Forum Topic and Process:** Summary of Symposium 1 on Quantifying Flood Risk and of Symposium 2 on Communicating Flood Risk, with conclusions that set the stage for the Forum on Managing Flood Risks and Resources
*Sam Riley Medlock, Policy & Partnerships Program Manager, ASFPM*

**2:15-4:15 pm** **What must we do to effectively Manage Risk to Humans and to Floodplain Resources?** Three speakers will explore the principal challenges in crafting and implementing a successful strategy for minimizing flood risk and protecting floodplain resources in the future. Questions and discussion by the Assembly.
*Greg Main, moderator*

*2:15-2:45 pm* **Challenges in Managing the Natural Functions and Resources of Floodplains**
*Jeanne Christie, Executive Director, Association of State Wetland Managers*

*2:45-3:15 pm* **Break**

*3:15-3:45 pm* **Behavior Factors and How to Effect Change in Flood Mitigation**
*Dennis Mileti, Professor Emeritus, University of Colorado–Boulder*

*3:45-4:15 pm* **Setting the Stage for National Flood Risk & Resources Policy and Strategies**
*Doug Plasencia, ASFPM Foundation Trustee; Michael Baker, Jr., Inc.*

**4:15-5:00 pm** **A Vision of the Management of Risks to Humans and to Floodplain Resources**
As a nation, what do we want to accomplish by undertaking a comprehensive strategy for managing flood risks and risks to floodplain resources? What will "success" look like?
The Assembly will brainstorm a vision of successful flood risk and resources management—its possible outcomes, components, and benefits.
*Gerry Galloway, University of Maryland, facilitator*

**5:00-7:00 pm: Networking Reception**

## Wednesday, March 10, 2010

**8:30-8:45 am** **Group Assembly to Issue Charge for Breakout Discussions.**
*Doug Plasencia*
Based on the vision of a nation in which flood risks to people and also risks to floodplain resources are effectively managed (as envisioned in the final, brainstorming session on the previous day), what challenges are we facing? How do we get from here to there?

**8:45-10:15 am** **<u>Session One (Break Out)</u>: What Indicators should we use to Gage Progress in Managing Flood Risk and Floodplain Resources?** The Assembly will divide into three groups. Each group will (1) identify the most important indicators (perhaps five) of ways in which risk and the status of resources can be monitored and/or measured for purposes of a comprehensive strategy for managing flood risk and resources; (2) list the barriers that are preventing us from already using each indicator; and (3) suggest ways in which the barriers can be overcome.
*Facilitators: Bruce Bender, Chad Berginnis, Linda Manning*

**10:15-10:45 am** **Break and transition to amphitheatre for feedback session**

**10:45-11:30 am** **Feedback Session #1.** A spokesperson from each group will display the group's dashboard and briefly describe its highlights and any problems encountered. Discussion by the Assembly and consideration of contradictions or challenges, if any.
*Gerry Galloway, facilitator*

**11:30-12:30 pm** **Lunch** *(participants' choice in first-floor food court)*

**12:30-2:15 pm** **<u>Session Two (Break Out)</u>: How do we foster the individual, household, organizational, and government behaviors that will cause our dashboard indicators to show improvement?**
Back in the same three small groups, participants will first make adjustments to their dashboards if needed, based on what they heard during Feedback Session #1. Next they will (1) identify the behaviors that are needed from individuals and from organized entities in order to generate a positive change on one or more of the dashboard indicators (these behaviors should be prioritized and separated into two categories: individual/household behavior and institutional/collective behavior); (2) identify the barriers that are keeping these desirable behaviors from taking place; (3) suggest how those barriers could be overcome with management actions. After discussing the behaviors needed, the groups should reconsider their dashboard indicators to see if additional gages are needed to track changes in behavior.

*Facilitators, same as in Break Out Session 1*

**2:15-2:45 pm** **Break and transition to amphitheatre for feedback session**

**2:45-3:15 pm** **Feedback Session #2.** Each group's facilitator will present (1) the five highest-priority individual/household behaviors that are needed to make the dashboard indicators show progress, and (2) the five highest-priority institutional/collective behaviors that are likewise needed; and (3) a short summary of that group's suggestions for fostering the needed behaviors. Discussion by the Assembly to refine the composite dashboards in light of Breakout Session #2, if needed.

**3:15-4:15 pm** **Session Three (Plenary): An Action Plan for Management of Risk to Humans and to Floodplain Resources**. The Assembly will catalog its recommendations for monitoring progress and for better managing floodplain risks and resources under three broad areas: (1) authorities for risk management and resource protection, (2) policy and programs, and (3) research and data.

*Doug Plasencia, facilitator*

**4:15-4:30 pm** **Wrap Up** Next steps to be taken by the ASFPM Foundation, the ASFPM, and others to advance the recommendations made by the Assembly. Discussion of possible topics for the next Assembly of the Forum.

*Scott Edelman and Larry Larson*

**4:30 pm** **Adjourn**

*Thank you to our Sponsors who enable us to host the Forum at no cost to participants.*

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# Part 1

# Outcomes and Indicators—
# Recognizing Progress

# LAUNCHING A FLOOD RISK AND RESOURCES *MANAGEMENT* STRATEGY

**Doug Plasencia**
***Michael Baker, Jr., Inc. and***
***ASFPM Foundation***

**Why Flood Risk MANAGEMENT?**

"Flood Risk" has emerged as a way to quantify and perhaps be used as a milestone to measure how we mitigate the manner in which flooding impacts us as individuals and as a nation. Flood Risk moves us beyond simply quantifying depth and the areal extent of flooding within a flood hazard area. Flood Risk for the first time allows us to consider the joint impact of hazard and consequences. In the end, and in spite of these advances, Flood Risk needs a unified national management strategy to make a difference.

For too many years as practitioners and policy makers we have bantered about terms such as floodplain management, storm water management, watershed management, wetland management, and other similar terms. The end result, with perhaps the notable exception being the "no net loss" wetlands strategy, is that all we have done in these areas is assemble a set of tools under the banner of "management" that, in of themselves, are good but—lacking a strategy—simply are not management. We wring our hands on regulatory policies that have been reached by compromise and that solve short-term concerns but can exacerbate our flood risk problem over the long haul. We follow investment principles that really are based on using our nation's water resources (raw water or the adjoining riparian and floodplain lands) as a catalyst to spur economic growth, yet we fail to consider whether these investments are spurring our flooding problems and whether the economic growth fostered this investment could occur in many other locations that are not floodprone.

In short, if flood risk is going to truly make a difference it must include a management strategy.

**Potential Elements of this Management Strategy**

**Objectives and Goals—**Collectively there is a need to establish national goals that would guide and focus resources and programs. The December 2009 draft revisions to Principles and Guidelines, titled *National Objectives, Principles and Standards for Water and Related Resources Implementation Studies*,(OP&S) takes a very important step by recognizing the need to establish national objectives that serve as qualitative guides, or perhaps boundary conditions, on a process that for too long has been primarily an economic optimization strategy. The national objectives set out at the highest level are:

- Protect and restore natural ecosystems and the environment while encouraging sustainable economic development;
- Avoiding adverse impacts to natural ecosystems wherever possible and fully mitigating any unavoidable impacts; and
- Avoiding the unwise use of flood plains, flood-prone areas and other ecologically valuable areas.

Whether these objectives are sufficient or complete will be part of a debate that will unfold over the next year, but the critical factor is that we are now setting forth targets that, if properly executed, will guide and potentially provide priority in how we address the nation's water resource investments.

There is an absolute need to ensure that these national objectives are consistent and sufficiently aggressive for a flood risk management strategy, but presuming that the final objectives meet that test; then the next step would be to establish broad goals that would further refine and prioritize the nation's investments in projects and regulations. Within the context of flood risk management, the tendency has been to think purely in terms of flood risk being the product of probability of occurrence and damage. However, based on Symposia 1 and 2 of the ASFPM Foundation's Gilbert F. White National Flood Policy Forum series on flood risk management; the consensus opinion is that flood risk must be broadened to include floodplain functions and resources, and some measures of social impact. The national objectives in OP&S are trending in a direction similar to the thinking that has occurred to date with this current Forum series, and perhaps when perfected will offer the umbrella needed to set national flood risk management goals.

Some might suggest that it is sufficient to stop at objectives, but frankly with the looming issues we face in terms of increasing damages and loss of ecosystems, coupled with climate change and diminishing financial resources; we can no longer "shotgun" our way to a solution. Rather, we must focus on specific targets. Our project and regulatory solutions must be aligned towards meeting common goals.

**Indicators, Behaviors, and Strategies—**As a nation we need to collectively debate and arrive at goals that are consistent with our national objectives but next we need to agree on indicators (including how we measure and fund these indicators).

Not only do we need to agree on the indicators, but also we need to have our best minds come together and determine how we influence collective and individual behavior so that the indicators are moving in a positive rather than an adverse direction. We need to evaluate whether projects and regulations that promote increased flood risk are in the best interest of the nation. We need to ask the tough questions as to whether the economy being "created" in these decisions would have occurred anyway but the floodplain was simply a convenient place for this to happen. We need to evaluate how much longer we promote policy that is silent on the creation and transfer of flooding problems to others in a watershed, and how much longer we allow this development to externalize its future disaster cost to the nation's taxpayers. In some cases, the regional or national significance of a developed local is so vital that these tradeoffs may be necessary, but in many other cases these impacts may no longer be tolerated.

Some have envisioned flood risk to be a single number and hence indicator, but the reality is that if we are to have a comprehensive approach to flood risk management we will need a number of indicators. We need to envision these indicators in the way one might envision the dashboard of an automobile. There are larger gages that warrant continued monitoring and frankly dominate

the dashboard, but there are other indicators that perhaps signal the health of the engine. For flood risk our indicators might include things such as a risk number, natural resource health, adverse flood risk creation (or reduction), and many other potential indicators.

**Data and Tools—**The success of a flood risk and resources management strategy will rest on the data we use to make decisions. This is not to suggest that we put off making tough decisions waiting for the data to arrive, but it does mean that our ability to manage effectively and efficiently will be directly influenced by the data and tools available to support these efforts. No longer can we delay the decision to invest in inventories of floodprone lands, buildings at risk, and water-based resources and functions; and we need to be prepared to make a continual investment in maintaining and applying this essential data.

**Conclusion—Making a Difference**

Flood Risk, in concept, affords an opportunity for the nation to measure trends in flooding and the quantity and quality of floodplain resources. However, to move flood risk from being simply a "barometer" of floodplain condition to making a difference it must be founded on a goals-based management strategy.

# TOWARD A NATIONAL AGENDA FOR FLOODPLAIN PROTECTION AND RESTORATION

**Mark P. Smith**
***The Nature Conservancy***

Floodplains are among the most productive and diverse ecosystems on earth, with more species of plants and animals than most other types of landscapes.[1] This diversity is a result of their dynamic nature, which is driven by the movement of water, sediment, nutrients and organisms between rivers and their floodplains. These natural processes create a shifting mosaic of habitat types at the boundary between freshwater and terrestrial systems, contributing to the health and productivity of rivers and their surrounding areas.

Floodplains provide a wealth of services to society: they store floodwaters, protect water quality, provide rich soils for agriculture, and support abundant fish, birds and game for harvest and recreation. As a result, floodplains have long been highly desirable locations for people. We build our communities, roads and railroads in these flat valley bottoms, make use of their rich soils and abundant natural resources, and depend on their proximity to rivers for navigation and waste disposal.

It should come as no surprise that floodplains are among the most cultivated and converted ecosystems in the world,[1] nor should we be surprised that our flood risk continues to rise.[2] The outlook for the future is no better. Continuing development in floodplains will place more people in harm's way and development in the floodplains and elsewhere will increase runoff as we replace wetlands, forests, and grasslands with more impervious surfaces. At the same time climate change is expected to bring more frequent and more extreme storm events to many parts of the country.

A significant factor in the incompatible use of floodplains is the investment we make in flood control structures that can encourage development in these high value, high risk areas. Levees disconnect floodplains from river flows and thereby diminish natural flood storage capacity, expand downstream floodplains, and prevent the flow of water, sediment, and nutrients from sustaining floodplain ecosystems.

There has long been a recognition that the highest and best use of many floodplains — for both people and nature — is to allow them to exist in their natural state. The Association of State Floodplain Managers (ASFPM) has been a leader in articulating these values and the need to include these natural functions as management objectives. The ASFPM's *2007 National Floodplains Policy and Review* includes several specific recommendations for a national agenda for maintaining the natural functions of floodplains, including:

- A national riparian zone policy to encourage actions to protect, maintain, and restore the areas along rivers and streams so they provide their natural benefits and remain sustainable ecosystems (p. 31).
- A new national emphasis on protecting and maintaining the natural storage capacity of suitable areas within all watersheds, through a variety of means including the preservation of natural areas (p 32).

- Having FEMA, the U.S. Fish and Wildlife Service, U.S. EPA and NOAA produce resource maps of the nation's floodplains (p. 32).
- Establishing and funding a dedicated program within the Corps' specifically for environmental restoration projects and establishing a system so these projects do not compete against traditional water resource development projects (p. 31).
- Including a resource management strategy as part of the preferred plan for any future federal investments in the floodplain. (p. 31)
- Encouraging continuous buffer zones along rivers, streams, coasts, and smaller waterways through actions such as converting existing or new private land owner programs to a permanent nationwide easement program for riparian buffers and floodplains. (p. 32)

Similarly, a recent article in *Science*[3] (whose authors include three TNC scientists) articulates the need for a large-scale shift in land use and policy to achieve economically and environmentally sustainable floodplain management. The paper proposes a movement toward large-scale reconnection of floodplains to reduce flood risks, increase the goods and services provided by ecologically intact floodplains, and increase resiliency to climate change.

2010 is an opportune time to get such efforts underway. This past year the National Levee Safety Committee issued its draft report and offered 20 specific recommendations for improving the management and safety of the levee system nationwide. These recommendations included developing an expanded national levee database and creating a new National Levee Rehabilitation, Improvement, and Flood Mitigation Fund.

Yet focusing only on levees, important as levee safety is, without focusing on floodplains will provide an incomplete picture of the needs and opportunities for more effective flood and floodplain management. Congress and the Administration should be encouraged to convene a similar multi-agency effort to develop a national floodplain protection and restoration plan. Such a plan would map the natural resources, flood storage capacity, relative ability to provide flood-risk reduction, and current condition of floodplains across the nation.

The purpose of this plan would be to identify intact or restorable floodplains that provide high public safety and natural resource benefits (or both) so they can be prioritized for protection and restoration. Such a national plan, developed in close coordination with the states, would provide the first blueprint to a more holistic, system-wide and watershed-based flood and natural resource management.

A national floodplain protection and restoration plan would have several important uses. It could be used to help prioritize the expenditure of existing land wetland protection funds, from agencies such as U.S. Fish and Wildlife, the U.S. Forest Service, NOAA and the states. Such a national plan could also help target Clean Water Act wetland mitigation activities to high value areas within watersheds. It would also help identify areas where farm bill programs might target private landowner program funds. Finally, the plan would help identify a set of potential floodplain reconnection projects that could achieve multiple benefits, such as ecosystem restoration and flood-risk reduction.

A national floodplain protection and restoration plan can be developed in iterations. In the short-term the agencies and states can use existing data to identify intact floodplains to be considered

for protection. Over the long-term, methods can be developed in conjunction with the floodplain mapping modernization efforts to use LIDAR data to more accurately identify areas of significant flood storage, use information on levees, and use more detailed natural resource data to allow the national plan to evolve into the future.

Comprehensive watershed and floodplain management is at the heart of the No Adverse Impact approach successfully advocated by ASFPM. The identification of potential floodplain protection and restoration opportunities will give communities, counties, states and federal agencies another tool to help reduce existing flood risks while providing for future compatible development and natural resource protection.

## Endnotes


1. Tockner, K. and J.A. Standford, *Environmental Conservation* **29** (3): 308–330, 2002.
2. J. Pielke, R. A., M. W. Downton, "Flood damage in the United States, 1926-2000: A Reanalysis of National Weather Service Estimates" (University Corporation for Atmospheric Research, 2002).
3. Opperman, J.J., et al., Sustainable Floodplains through Large-scale Reconnection to Rivers, Science, **326**, 1487-88, 2009.

# HOW CERTAIN ARE WE ABOUT OUR FLOOD RISK?


## Larry Larson
## Association of State Floodplain Managers



*This paper is adapted from an article that appeared in the Natural Hazards Observer, July 2009, p. 9-12..*


"A little knowledge can be a dangerous thing." That timeless aphorism describes all too well this nation's efforts to manage our flood hazards, beginning a century ago and continuing even today.

The last few years have been a wakeup call for practitioners, policymakers, and scientists alike. Floods appear to be occurring with increasing frequency and unfamiliar intensity, and certainly are causing more damage. The deteriorating condition of much of our flood-related infrastructure—levees ,dams, bridges, culverts—has become well known through investigations and documentation produced by the U.S. Army Corps of Engineers, the American Society of Civil Engineers, the Association of State Dam Safety Officials, and others. We have endured several years of frightening hurricane seasons, punctuated by the Katrina disaster, which resulted from the combination of insufficiencies in infrastructure with a serious (but not the highest-intensity) hurricane. As if to cap the situation, anticipated (and already-occurring) changes in climate, whatever their cause, threaten to make flood-related (and other) hazards of the future even harder to address.

How did we get here? Among floodplain management professionals a consensus is growing, based in part on the benefits of hindsight, that we have failed to factor in all that we know and all the uncertainties, ambiguities, and unknowns inherent in our flood risk.

### Flood Risk as a Complex Concept

It has been all too easy to allow differing concepts of "risk" to influence our understanding of it, and how to manage it. Risk researchers and analysts usually define risk as the product of the probability of an event's occurring and the consequences if it does. In flood hazard terms,

Probability of a flood (of a given Magnitude) x the Consequences of that flood = Flood Risk

We have been trying to alter the outcome of the formula (overall risk) by addressing one or two components and ignoring the others. That's a recipe for failure.

### Uncertainty about Probability

We use the historical record of rainfall, streamflow, tidal activity, and other events to estimate the probability (how often) that a given size flood might occur. The short time frame (in real terms and especially in geomorphological terms) for which we have documentation of these relevant events necessarily undermines the accuracy of our estimates. In addition, we often throw out the "high outliers" so that the most extreme flood events experienced are not used in the analysis. This has been well illustrated by the recent public and scientific debate over climate change. Scientists note that, of course, climate is always changing, but our record of past changes is a generalized one, insufficient for accurate probability estimates.

On top of these uncertainties, predicting probabilities is complicated by many other factors. For example, development within the watershed can cause a significant increase in flood

levels (studies for the Charlotte/Mecklenberg area of North Carolina showed 2 to 9 feet increase) and structural flood control projects themselves can increase flood damage across the river or upstream and downstream. Also, when human development of any sort disturbs the natural functions of floodplain areas, such as by filling flood storage areas, the characteristics of the flooding are inevitably altered.

**Underestimating Magnitude**

All three of the ways by which we predict the magnitude of a flood—flow frequency analysis, regional regression equations, and design storm runoff models—have inherent uncertainties. Not only does each step of the process incorporate assumptions, but also the methods rely on imperfect underlying data, notably stream gage and precipitation records. Besides, as noted above, the period of time for which we do have data is too short and, because of climate change, what appeared to be a trend in the past may not hold for the future.

An additional, insidious way in which we have underestimated magnitude has been by the use of an arbitrary prescriptive standard, the 100-year flood. Originally intended in the 1960s as a compromise level that would serve as a norm while national policy and flood insurance were being experimented with, it has instead become institutionalized and misconstrued as a safety standard. Unfortunately, it has become clear over time that, if we are to use the standard in this way, it should have been set much higher, perhaps at the 500-year flood level, or at the very least a standard that varied based on the consequences of flooding for a given area. As a final insult, in many cases what was a 100-year flood when the flood maps were produced is now a more frequent occurrence because of alterations to our watersheds, making the flood level depicted on maps too low for current conditions.

**Consequences Unexplored**

Our historical view of the consequences of flooding has been a narrow one, focusing first on deaths and injuries and then adding damage to public and private property as impacts to be reduced or avoided.

In fact, we now realize that the consequences of flooding take a range of forms, including social, financial, cultural, and environmental impacts. In addition, many consequences of flooding are beneficial, because they are a function of the natural processes that sustain ecosystems. Unaltered marshes, dunes, bluffs, wetlands, and other features that often occur only in or mostly in floodplains have intrinsic value, and, as an added benefit, absorb flooding impacts so that human development is protected without human intervention.

In the socioeconomic arena, the costs of flooding must be borne by someone. In our current framework, those who choose to live at risk from floods are allowed to externalize a large portion of the consequences of that choice (the costs of damage, recovery, rebuilding, etc.) to other segments of society—usually the federal taxpayer. Further, there is an absence of shared responsibility among public entities: states and localities have come to believe that protecting people from flooding is a federal responsibility, when in fact it is not and, even if it were, it would not be possible to reduce costs and suffering without participation by all players, in partnership. Yet federal assumption of costs provides a disincentive to other levels of government (and private parties) to take action on their own. The most effective solutions to reducing costs and suffering are vested in land use and building codes. Under our Constitution, the authority for those rests in local and state government, with the federal government having no authority.

Companions to the far-reaching consequences of floods are the similarly far-reaching consequences of our efforts to control them. This includes the costs of flood control measures (again, usually borne by federal taxpayers) and their unanticipated impacts on ecosystems, which have the potential to harm everyone. Floods carry sediments that build deltas and nourish beaches, but levees, dams, and coastal groins interrupt this replenishment—resulting in subsiding wetland estuaries and sand starved-eroding beaches. When we design and build projects (levees, dams, stormwater etc.) with a too-short project life, protection levels that are too low, and maintenance arrangements that are sketchy, we are introducing additional negative consequences into the risk equation. In some cases flooding may be deferred in smaller events by these measures, but when a flood exceeding its protection level does occur and the structure fails or is overcome, the consequences are catastrophic.

Our well-meaning flood management techniques likewise have had unintended but enormous consequences. Our program of flood insurance, for example, uses maps to depict the boundaries of the aforementioned 100-year standard (not a rare event). This "line on a map" approach has inadvertently conveyed to the public and decisionmakers a certainty about the risk that did/does not exist and also fosters a belief that it is "safe" to build outside of the flood hazard displayed on the map. Our national policy approach once we identify the flood hazard area is, paradoxically, not to show people how to avoid it, but rather how to build in it. There is a small "no build" zone on rivers (the floodway), but none in coastal areas subject to high storm surge—where there is huge risk exposure (an example is the surge of 30'+ along the Mississippi coast in Katrina).

Further, the pervasive misunderstanding of the flood risk has inhibited sensible behavior, both individually and collectively. In the public sector, development decisions tend to be made based on short term economic return rather than long term sustainability. This risky development eventually results in significant financial costs. People don't understand or perceive the flood risk, therefore they don't avoid floodprone areas, buy flood insurance, or take other self-protective actions that would reduce their risk.

As a last complication, the consequences of flooding in the future are likely to increase. Our population is growing rapidly. We are becoming increasingly urbanized, meaning that more of the land surface is disturbed, usually converting land that used to absorb water into impervious surface where water runs off and increases the flooding. It can be expected that our future coastal areas and lands adjacent to waterways will be more densely populated than they are even now.

**Levees as a Case in Point**

The way we build, use, and manage levees is one good illustration of how the many uncertainties in the risk equation come into play to create potentially disastrous situation.

**Levees reduce ordinary flooding, but contribute to catastrophic damage in extreme flood events—**When a levee is built to control or minimize flooding to existing buildings, the levee is most often only designed and built to protect to the 100-year flood level, and no other flood risk measures are required behind the levee—no flood insurance, no elevation of buildings, no access for people or emergency vehicles when the levee overtops or fails, etc. It is an "all or nothing" approach through which people become complacent during smaller floods, thinking they will always be safe from flooding, even though there have been dire consequences from levee-related flooding in the last few years, in the Midwest, California, and on the Red River, and elsewhere. Current national policies create this situation, as we have seen, yet those policies have not been changed in decades.

**Poorly estimated magnitude—**All the problems noted above with calculating the discharge for the design event come into play with levees. In addition, the calculations are for yesterday's flood, not tomorrow's flood; the latter would be based on planned watershed development and/or climate change. Many of the levees in the nation that were thought to be built to withstand the 100 year flood no longer do, because the level of the 100 year flood has changed. Other nations, such as Germany and The Netherlands, not only design to a higher standard (e.g., the 1,000- or 10,000-year event) but also add 15 to 25% to the calculated design flows to account for future increases from unknowns.

**Unintended consequences—**Levees will usually cause an increase in flood levels on other property, either across the river, upstream, or downstream. Those increases may affect an area that is already developed, or a non-protected area. In either case, other properties are adversely affected, which impinges on the owners' property rights. This same problem occurs with temporary levees put up during flood fighting operations, and some of these temporary levees are installed and taken down time after time, with no compensation paid to those nearby landowners whose property has been inundated by the higher water levels the levees cause.

**Collection of water behind a levee—**Rain water will collect behind a levee, since it can no longer flow to the river. Likewise, water seeping through a levee will collect behind the levee. In any case, the water must be pumped out to keep structures behind the levee dry or at least at lessened risk. This introduces other risk uncertainties: Are the pumps big enough to handle all the water? Will they be operable during a catastrophic event? Will operators be there to staff the pumps? We heard the unfortunate answers to the last two questions during Katrina.

**Planned failure points are not built into levees—**Dams are designed with emergency spillways that will bypass floods that exceed the design flood. This adds resilience and long term reconstruction savings by ensuring that the dam will not completely wash out. Levees could be designed similarly, with planned failure points, but they rarely are. Sections of the levee might be built lower and reinforced, allowing extreme floods to flow over into sections of open or minimally developed land without washing out the levee.

**Who pays?** In the case of levees, the answer is, in large part, the federal taxpayer. Levees are typically built by the US Army Corps of Engineers. Design and construction costs are usually paid 65% by federal taxpayers and 35% from non-federal sources. Operation and maintenance costs are supposed to be borne by the local sponsor, and some sponsors do a good job. However, there is now a big push for Congress to provide federal taxpayer dollars to bring levees up to standards because local sponsors failed to properly operate and maintain them over the years. The Corps also has a repair and rehabilitation program whereby local sponsors belonging to this program can have the levee rebuilt after it fails or overtops, with either 80% or 100% federal taxpayer funds.

**Increased development behind levees increases the risk—**Perhaps the largest factor increasing risk and costing taxpayers money associated with levees is the lack of land use controls behind the levee. In the past, many levees protected agricultural areas, so if the levee failed, the consequences were short term and recovery was not complicated. However, because there was no land use control behind these agricultural levees, development of all kinds occurred behind them, with no controls to provide even some level of safety in the event of failure or overtopping. Levees are often built in deep floodplains, where the failure or overtopping results in 10 or even 20 feet of water on and in structures. This results in total damage to the structure, whereas elevated buildings that are in designated flood hazard areas but without the tenuous

protection of a levee might experience no water, or just a foot or so, in extreme events. Because of the very severe consequences, one could argue that the "residual risk" behind even well-maintained levees is higher than that in unprotected areas. This is especially true if you take into account the costs associated with the environmental impacts of levees and the business closings, job losses, domestic violence, increased number of suicides and flooding deaths that occur in catastrophic levee failures.

**Buy down risk in many ways—**There are many ways to reduce ("buy down") the level of flood risk, with a levee just being one of them. The levee neither takes away all risk, nor does it relieve the community of the obligation to consider other options or combinations to provide for a safer and more sustainable community. Requiring flood insurance, zoning and building code requirements, evacuation planning and exercises, outreach with notification of risk to all property owners behind the levee all can be used in combination, with or without levees, to reduce risk. Even if all of the measures are taken, it is important the everyone understands that there is still residual risk. (See the risk chart at the end of this paper.

**Working the entire risk equation—**There are those who believe the solution to the levee problem is better engineering. This can affect the probability of failure, and if standards are increased from the 100-year protection level to something like the probable maximum flood, the probability of overtopping can be reduced. But it does nothing to the consequence part of the equation. So if everything else remains constant and development is increased in number or value, the risk still increases. Appropriate planning and zoning is the real key to flood risk reduction. Wise use of our floodplain and watershed lands can reduce, or at least maintain the current risk, so taxpayers don't get stuck with the cost of ever increasing disasters.

So, in the case of levees, we have tampered with the risk equation in several ways: by ignoring (or discounting) the probability of failure or overtopping of the levee; by underestimating the consequences of a failure; by conveying to the public and to elected officials that a higher level of safety exists than really does; and by failing to ensure that the costs and consequences of the levee itself and of any flooding that occurs are shared among those who benefit from the levee.

### Needed Changes

Flood policies need to be based in science. A methodical approach to analyzing every component of the risk equation before making management or project decisions is sorely needed. We have put too much focus on predicting the probability of a flood and on delineating its magnitude, without recognizing the limitations of our abilities to do both of those things. We have failed woefully to evaluate consequences both of flooding (of existing and future development) and of our attempts to cope with it.

### Challenges for Hazards Research

- Refine and enhance hydrologic modeling so that estimates of probability and magnitude are continually improved.
- Develop accurate, scenario-based models useable by decisionmakers at all levels, so that current and future consequences of all flood risk mitigation alternatives can be fully evaluated individually or in combination.
- Expand interdisciplinary work: refine hydrology, develop risk analysis models that depict and communicate flood risk in ways that are based on knowledge about what changes human behavior.

- Continue refinements in digital mapping, especially refining display and presentation to convey complicated scenarios of flood risk.

**Challenges for Floodplain Management Professionals**

- Recognize that we often don't know as much as we think we do when it comes to calculating flood risk; add factors of safety, like freeboard, to help account for that uncertainty.
- Expand the conceptualization of consequences to look far into the future and deep into the potential social, economic, and environmental reverberations of flooding and of our efforts to manage the risk it brings.
- Critical use facilities demand a higher level of protection than ordinary residential and commercial development. Hospitals, police and fire stations, water supply and wastewater facilities, emergency evacuation roads and others need to be protected and operable during an extreme flood. In order to protect lives and sustain a community there must be a higher level of protection—at least the 500-year or probable maximum flood.
- Use and integrate what we already know and are discovering about, for example, global warming impacts. Don't fall back into the previous trap of expecting clear and solid evidence about all aspects of risk. Err on the side of caution—a "no regrets" approach.
- With new digital mapping and computerized rate setting, we should be able to do a much better job of rating flood insurance. Rates should be actuarial and should consider all aspects of the flood risk, not just probability. Some areas with very deep or high velocity flooding should probably not be offered flood insurance at any cost. Those with the potential for very shallow flooding should probably have a lower cost than current rates.

**Challenges for the new Administration and Congress**

- Restore science-based policy. This will help to narrow the uncertainty gap, by ensuring that decisions are based on sound research, investigation, and evaluation.
- Foster individual and household self-reliance by making the consequences of failing to address flood risk fall on those who fail to act.
- Support risk-based (actuarial) hazard insurance, and consider making its purchase mandatory for everyone. Be realistic about broadening the risk pool if flood insurance is only mandatory in the 100-year floodplain, since 30% of claims are for properties outside of the identified 100-year flood zone.
- Address insufficiencies in infrastructure, including higher protection and performance standards in new construction and repair. Investments must be made in rehabilitating existing flood protection infrastructure but should not be made for new projects except in already densely settled areas.
- Invest in basic data, such as stream gages, flood damage in each event, insurance claims data by property, and detailed topographic mapping.

## Conclusion

As a society we must act as wisely as we can, based on the best scientific and other valid information available to us. Scientists, practitioners, and decisionmakers of decades past undoubtedly believed they were doing that. But the benefits of hindsight, supplemented by the strong dose of humility being administered to us by Mother Nature, should be enough move us toward the future with more caution, with more scrutiny of our surroundings, and with a methodical, scientific technique for managing our flood risk.


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# 21ST CENTURY WATER RESOURCES CHALLENGES

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We are in the midst of a continental-scale, multi-year experiment in the United States, in which we have not defined our testable hypotheses or set the duration and scope of the experiment, which poses major water-resources challenges for the 21st century. What are we doing? We are expanding population at three times the national growth rate in our most water-scarce region, the Southwest, where water stress is already great and modeling predicts decreased streamflow by the middle of this century. We are expanding irrigated agriculture from the west into the east, particularly to the southeastern states, where increased competition for ground and surface water has urban, agricultural, and environmental interests at odds, and increasingly, in court. We are expanding our consumption of pharmaceutical and personal care products to historic high levels and disposing them in surface and groundwater, through sewage treatment plants and individual septic systems. These substances are now detectable at very low concentrations and we have documented significant effects on aquatic species, particularly on fish reproduction function. We don't yet know what effects on human health may emerge, nor do we know if we need to make large investments in water treatment systems, which were not designed to remove these substances. These are a few examples of our national-scale experiment.

In addition to these water resources challenges, over which we have some control, climate change models predict that precipitation and streamflow patterns will change in coming decades, with western mid-latitude North America generally drier. We have already documented trends in more rain and less snow in western mountains. This has large implications for water supply and storage, and groundwater recharge. We have documented earlier snowmelt peak spring runoff in northeastern and northwestern States, and western montane regions. Peak runoff is now about two weeks earlier than it was in the first half of the 20th century. Decreased summer runoff affects water supply for agriculture, domestic water supply, cooling needs for thermoelectric power generation, and ecosystem needs. In addition to the reduced volume of streamflow during warm summer months, less water results in elevated stream temperature, which also has significant effects on cooling of power generating facilities and on aquatic ecosystem needs.

We are now required to include fish and other aquatic species in negotiation over how much water to leave in the river, rather than, as in the past, how much water we could remove from a river. Additionally, we must pay attention to the quality of that water, including its temperature. This is propelled, in part, by the US by the Endangered Species Act and the Clean Water Act. Furthermore, we must now better understand and manage the whole hydrograph and the influence of hydrologic variability on aquatic ecosystems. Man has trimmed the tails off the probability distribution of flows. We need to understand how to put the tails back on but can't do that without improved understanding of aquatic ecosystems.

Global change and water resources challenges that we face this century include a combination of local and national management problems that are already upon us, as well as emerging and future problems that are closely associated with rising temperature and changes in the distribution of precipitation in time and space.

# WHAT IS PREVENTING US FROM BUILDING FLOOD-RESILIENT COMMUNITIES, AND WHAT CAN WE DO TO BREAK DOWN THE BARRIERS?

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## Issue

What does a flood-resilient community look like? A community that is capable of preparing for extreme inland or coastal floods before they occur and rebounding quickly and efficiently after the event, ensuring that:

- Critical infrastructure (e.g., hospitals, schools, emergency response capabilities) is located out of high hazard areas;
- Vulnerable populations are identified and strategies are adopted to prevent them from being disproportionately affected by flood events and to ensure that they can bounce back quickly;
- Wetlands, barrier islands, and other "green infrastructure" are protected and restored to maintain their ability to protect communities from short- and long-term flooding impacts; and
- Economic vitality is maintained to ensure that the local economy is able to recover quickly after an extreme flood.

Community resilience is a complex national issue with regionally focused impacts and solutions. Resilience involves pursuing effective risk management strategies across all major systems, including the built environment, ecosystem services, and socio-economic resources. Major considerations include:

- The increasing flood risk from climate change associated with less frequent but more intense rainfall events, more frequent/intense storms, droughts, and sea-level rise;
- Other existing threats to critical natural systems and resources (e.g., protective barriers, water resources, biodiversity); and
- The human-dimension factors inhibiting resilience, ranging from perceptions of risk, attachment to place, and land-use law, to political influence, poverty, and no mandate or requirement to plan for sea-level rise or other climate-related hazards.

To actively pursue making communities flood resilient, decision makers require improved understanding of flood risk and vulnerability to evaluate long-term economic and societal costs. In many cases the same decision makers are also trying to grapple with planning for climate change impacts, such as sea-level rise. The beauty is that in many cases hazard mitigation strategies for flood impacts, droughts, wildfires, and other natural hazards can also be used to mitigate climate change impacts. This is a "two for the price of one" multi-objective management outcome that will only be achieved by continued interagency, regional, and private-public partnerships.

## Change in Focus

The National Oceanic and Atmospheric Administration's (NOAA's) interest in community-based risk, vulnerability, and resilience preceded the 2004 and 2005 active hurricane seasons. However, it took Hurricane Katrina to focus a national spotlight on community and economic resilience issue. Since Katrina, increased interagency and regional collaboration (e.g., the Gulf of Mexico Alliance) has yielded prioritized needs and a strong state-federal partnership to address them. In addition, an emphasis on local and regional approaches is leading to more effective outcomes. And finally, national and regional frameworks, standards, and outcomes have focused more attention on coastal impacts, as well as the relevance and efficacy of private and public investments.

## Barriers to Success

Why is risk not the driving force behind decision-making regarding development and redevelopment? There are several barriers in place that have prevented this from happing. Historically, new development revenues are infused into local communities, yet flood losses are spread nationally (e.g., through National Flood Insurance Program [NFIP]). Legislative precedents for taking of property without just compensation exist and often stymie buyout programs. Existing federal policies, such as the NFIP, subsidize flood insurance for development in flood-prone areas. There is a lack of incentive or mandate for the range of state/local managers (i.e., emergency, floodplain, and resource managers, as well as land use and transportation planners) to work together toward effective solutions. And finally, communicating risk and urgency effectively to decision makers has been a struggle for the engineering and science community responsible for determining our flood threat.

There are several recent, federally sponsored efforts to improve coordination among agencies (federal and state) and with stakeholders on matters related to flood risk (e.g., National Flood Risk Management Program, U.S. Army Corps of Engineers' Silver Jackets Program) re-established Federal Interagency Floodplain Management Task Force). Many states and communities participating in the NFIP are working hard to more effectively manage their flood risks, using incentive programs such as the Community Rating System to better align best practices with financial benefits. Still, with the growing number and complexity of interests engaged in or affected by floodplain management decisions, many challenges remain.

## Needs and Opportunities

What is needed to break down these barriers to successfully achieve the outcome of flood-resilient communities is a new set of strategies and opportunities:

**Strategies**

- Improving the ability to not only accurately predict but also effectively communicate flood risk and impacts;
- Improving the ability to communicate risks associated with living, working, and doing business in floodplains;
- Developing best practices for reducing risks and enhancing community, economic, and ecosystem resilience (e.g., financial incentives, focus on efficacy, leveraging resources);
- Protecting and enhancing the full range of ecosystem services;

- Improving integration of social science into risk management;
- Identifying economic and social parameters of improved community resilience that are used to identify desired outcomes; and
- Improving understanding of the human-dimension impacts of extreme events.

**Opportunities (examples from the coastal zone):**

- Developing active interagency, regional, and NOAA partnerships
  - -Marine Sanctuaries, Weather Forecast Centers and River Forecast Centers, Regional Climate Centers, Sea Grant, National Estuarine Research Reserves
  - -NOAA Digital Coast Partnership (Association of State Floodplain Managers, The Nature Conservancy, National Association of Counties, National States Geographic Information Council, and the Coastal States Organization)
- Developing mutually beneficial private/public partnerships
  - -Trade, insurance, and financial services industries
  - -Chambers of Commerce
  - -Academia: regional research plans
  - -The Nature Conservancy, Trust for Public Land, Land Trust Alliance
- Cultivating strong political will
  - -Committed governors
  - -Congressional interest
- Effectively using federal resources and programs to achieve multiple objectives in and around our floodplains
  - -Habitat restoration, including projects funded through the American Recovery and Reinvestment Act
  - -Coordinated data and information collection and sharing, such as through the Integrated Ocean and Coastal Mapping (IOCM) initiative.

## The Path Forward

The new NOAA administrator, Dr. Jane Lubchenco, recently stated that short-term economic growth is what you get when you make decisions without considering ecosystems and habitats. Long-term prosperity is what you get when you work economics with ecosystems. As a floodplain management community, we need to develop a new fundamental business strategy to model collaborative behaviors that institutions can adopt to address issues too big to solve on their own. We can improve risk assessments by enhanced partnerships to provide social and geospatial data, infrastructure, and monitoring. We can translate risk assessments and demonstration projects into

- Actionable information with clearer communication of risk
- Step-wise adaptation strategies for local communities
- Economic information regarding the expected cost-benefit of enhanced resilience policies
- Collaborative, easy-to-use tools that can be applied by non-technical decision-makers to evaluate proposed scenarios and balance multiple competing priorities

By utilizing regional governance structures and multiple partnerships, including other agencies (federal, state, local) to transfer tools and best practices to other regions, we can develop more comprehensive, multi-use, and multi-objective, risk-based products, and ultimately, flood-resilient communities.

# FORGOTTEN LESSONS


## Glen Connelly
***Confederated Tribe of the Chehalis Reservation***


Many people, be they a developer, local official or environmentalist, will all agree that reducing damage due to floods is a great idea. The differences arise when you discuss what the specific problems are and how to fix them. Generally, most folks don't even think about flooding and what effects it may have on their lives, until they experience a loss for themselves. In southwest Washington State, debates such as these have been going on for over 100 years. The Chehalis River Basin covers 2700 square miles and a population of 140,000 people[1] and it is classic example of America's history around development and flooding.

Native American tribes have inhabited this area for tens of thousands of years and have depended heavily on the river to provide food (salmon) and transportation. The natives knew the river would regularly flood and thus expected the low lying areas to be inundated and uninhabitable. They built temporary camps near their favorite fishing grounds and expected to move as the seasons changed. They respected the power of the river and enjoyed the many benefits a healthy river provided.

In the 1800's, tribes in the area were relocated to federal reservations and could no longer roam the basin as they once did. The Chehalis Reservation, home to the Confederated Tribes of the Chehalis Reservation, consists of 4,200 acres along the Chehalis River. Over 75% of the reservation is in the active flood plain[2] and much of it is defined by old river channels, oxbows and wetlands. Over the years, the Tribal government has smartly restricted development to two glacial terraces that provide higher ground for the community. Zoning ordinances and other tribal laws ensure that impacts to critical areas, such as floodplains are minimized. They clearly see that the river needs room to move and the natural resources need to be preserved.

As European immigrants moved westward, they too carved out their settlements near the rivers in the region. The floodplains provided fertile soils and permanent settlements grew along the river banks. As cities and towns evolved, dikes and levees were built and lowlands were filled in to protect people and property. As land became more expensive and flood insurance became available from the government, some developers turned to the flood plains as bargain properties. More and more infrastructure and buildings were put into the floodplain as investors and developers prospered. Unfortunately, more people and property were being placed in harm's way.

All of those structures and their supporting infrastructure now suffer from more frequent flooding. Over the last 20 years, efforts to "prevent" or "control" flooding have emerged in our basin. The Army Corps of Engineers completed an extensive flood study in a nearby county (once known to settlers as Saunders Bottom because it is so wet and swampy[3]). Expensive levees, bypass channels and retention structures have all been proposed, discussed and analyzed as potential solutions.

Recently, many of the local jurisdictions formed a flood authority to find ways to reduce damages from flooding. While the focus is supposed to be basin-wide solutions, most of the meetings have been dominated by groups who want to build new dams. Sadly, local residents and regulators refuse to see development in the floodplains as adding to the problem. A neighboring jurisdiction has been putting thousands, upon thousands of cubic yards of fill in the floodplain. Over a six year period, they have added over 9000 structures to an area that could be impacted by a proposed levee project.[4] When asked what impact the fill was having on flooding, the local floodplain manager's simple (and short-sighted) answer was, "None."

I believe that the story of the Chehalis River is an example of the problem in America's river basins. Just because current law allows jurisdictions to fill the floodplains, it doesn't mean they should. Despite increased development regulations, more structures have been built in the floodplain and flood damages have been increasing steadily. Rather than methodically and systematically move structures away from the river, short-sighted residents would rather spend hundreds of millions, (if not billions of dollars) on man-made structures, so that they can continue to live near the river.

In addition to increased damages from flooding, degraded water quantity and water quality issues are becoming commonplace in our watersheds. Certain reaches of the Chehalis River and it's tributaries are on Washington State's 303d list of impaired waters, due to high temperatures, fecal coliform, low dissolved oxygen, high pH and high levels of phosphorous or pesticides.[5] Water related issues like these are also linked to development in the floodplains, yet most people refuse to see the connection.

The natural ecological systems that have been in place for eons provide valuable services for us, although there effects can be subtle. Our impacts (both immediate and incremental) cause damage to the natural ecosystem services and then we humans have to spend billions of dollars in an attempt to build replacement services, such as dams, dikes, storm-water control systems, aquifer injection systems, pollution treatment systems, dredging, habitat restoration projects, etc. While development is vital to the economy, we must not ignore the fact that destroying aspects of our ecosystem carries a very large price tag.

In the Chehalis River Basin there is a group called the Chehalis Basin Partnership (CBP) that has been improving the natural conditions of the watershed for over ten years. They focus on things like salmon habitat, water quality issues, summer flow patterns and development guidelines. Their basin-wide efforts have helped to restore some of the natural processes in the watershed. At the request of the CBP, the local flood authority hired the firm Earth Economics to collect ecological and financial data and apply it to a GIS layer of the Chehalis Basin. We may finally have a tool to more accurately weigh some of the true costs of development. Imagine the ability to place an approximate dollar value on how much flood protection is offered by a five acre wetland, or a three hundred acre forest! Economic valuations of natural systems is especially important because the federal government is required to analyze and make construction decisions based on predicted economic benefits.

Communities along the river have a history that is valuable to them and they don't want to change their way of life. Theoretically, change is acceptable, but when actual changes are proposed, people become resistant. A recent flood survey in the Chehalis Basin asked if people

in flood prone areas should pay for enhanced flood protection and the majority of the folks said yes, but when asked if they would support a fee or tax to pay for flood reduction efforts, the answer was mostly no. People do not want to "connect the dots" and see that they live in an area that floods and that their roofs, driveways and foundations are part of the problem. Only 31% of the people surveyed knew they were in a watershed![6]

Ultimately, a clear repetitive message is the key. Each of us live in a watershed and we each have an impact on the ecosystem. Federal, state and local governments need to start the process by promoting No Adverse Impact as a rule, not a recommendation. Recent changes in Washington State restricting development in the floodplain around the Puget Sound due to impacts on endangered species should be expanded to the whole state. Development projects should be assessed fairly to decide if the damage to our natural flood protection system is acceptable. If yes, than completely mitigate for the damages and consider compensatory mitigation to restore damage done in the past. Promote buy-out programs and improve planning efforts to create more open spaces along the rivers. These are long term solutions that have been proven to work.

The main message is to stop trying to alter the natural environment so that mankind can live close to the river. Dams, dikes, and fill are short sighted solutions to avoid flood damage. The frequency and intensity of flood events in our area are increasing [7]. If we allow the natural systems room to work, then our communities will benefit, over the long term. This strategy has worked for tribal communities and despite population increases and development pressures, it can work for all of us.

**Endnotes**

1. Chehalis Basin Watershed Plan, Grays Harbor County, WA 2004, Fig 1
2. Chehalis Tribe's Comprehensive Flood Hazard Management Plan, 2009, p.3
3. The Land Called Lewis, Sandra A. Cromwell, Panesko Publishing Co, 2007 p.23
4. Twin Cities Project, Joint Coordination/Technical Team Meeting notes, 2010
5. Chehalis Basin Watershed Plan, Grays Harbor County, WA 2004, pp.10-11
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# A NEED FOR COMPREHENSIVE CONSIDERATIONS OF FLOODPLAIN RISK


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***City of Arlington, Texas***


Historically, floodplain risk considerations have primarily limited to or focused on risks to residential or commercial structures. The human implications are typically focused on life and economic impacts. This limited focus does not adequately address the full range of risk considerations associated with floodplains. While some have acknowledged potential risks to other factors such as ecologic, biologic, cultural, archeological, or historical impacts, there is not a comprehensive process for addressing or communicating these considerations in a consistent manner.

In recent years, through the intervention of legal proceedings, the courts have begun to direct risk considerations associated with the Endangered Species Act be taken into account during floodplain assessments. Simultaneous with these developments, other federal agencies are beginning to evaluate the possible benefits of floodplain management and its impacts to the risk considerations related to water quality. The Environmental Protection Agency (EPA) in recent years has acknowledged a linkage between flood protection activities and water quality impacts. EPA's primary risk concern directed by the Clean Water Act is water quality and is directly related to ecologic, biologic, and health risks in the floodplain. Couple these recent trends with the cultural and socials risks related to environmental justice concerns for low income, tribal or minority communities in or near the floodplain, the need for comprehensive risk considerations is becoming more evident.

A comprehensive approach for evaluating floodplain risks could be modeled after the National Environmental Policy Act's (NEPA) Environmental Assessment (EA) or Environmental Impact Statement (EIS) process. While the NEPA process is typically focused on alternatives related to a specific project, it establishes a framework for a baseline review that evaluates multiple areas of risk and concern. The baseline framework would allow evaluations of risk concerns related to ecologic, biologic, cultural, and historical issues and put these risk concerns on par with the typical structural or economic risk considerations. This in the end, would result in a more comprehensive and consistent identification of floodplain risks.

# REDUCING FLOODPLAIN RISK BY BUILDING RESILIENCE

**Shana Udvardy**
***American Rivers***

**Introduction**

To fully address flood risk and the protection of floodplain resources within a changing climate, we advocate placing a priority on non structural solutions and ecological resilience. Scientists have estimated that flood plains contribute more than 25% of all terrestrial ecosystem services yet they make up as little as 1.4 % of land surface area.[1] Remarkably, although floodplains provide a large range of beneficial services to society, these landscapes are the most altered and they are disappearing at an alarming rate.[2] By protecting and restoring wetlands and floodplains, we build communities' resilience and provide rivers the room they need to accommodate flood waters and a changing climate.

**Background**

What do we mean by resilience and why do we want to make resilience part of our everyday language of flood plain protection? From the engineering perspective, resilience suggests stability, resistance to disturbance, one outcome, predictability, fail-safe, rigid boundaries, and redundancy of structure. In comparison, ecological resilience suggests the following: inevitability of change, absorbs and recovers from resistance, multiple outcomes, unpredictability, safe-fail, flexible boundaries, and redundancy of function.[3] What we gather from comparing these two perspectives is that ecological resilience allows for natural systems that are always in a state of flux and that function within a wide range of conditions. Resilience as a goal is important because it means working with nature instead of against it. If the natural systems fail, there will not be a catastrophe. We take the notion of resilience one step further and define it as the ability of a community to absorb disturbances or stresses caused by climate change without experiencing catastrophic losses or losing essential functions.[4] This definition encompasses multiple ideas including the ability to resist impacts from a disturbance, the ability to recover and respond productively, and the capacity to learn and adapt to changing conditions in order to limit future vulnerability. Our notion of resilience reaches beyond maintaining the "original" condition of an ecosystem or community and instead emphasizes the continued functioning in the face of a changing climate.[5] It is precisely for this reason that we must make ecological resilience a priority of flood management policy.

**Discussion**

All too often we hear the debate between either allowing for the conservation of our natural resources or allowing for new land development. It is more true today than ever that this type of debate sets communities up for a false choice. The solutions that allow for communities to gain resilience include strengthening ecosystems, creating flexible infrastructure, diversifying local economies, and providing multiple benefits.

***Sustaining Ecosystems.*** The ability of communities to survive and prosper will depend in large part on the health and resilience of ecosystems and their ability to provide vital services. Much like communities, ecosystems have a limit to the amount of stress they can absorb before they undergo fundamental changes and lose essential functions. Natural buffers for example can reduce nutrient-laden agricultural or urban runoff and help ensure the future of healthier stream systems that will be better able to process the excess nutrients carried by increasingly severe storms without experiencing large algal blooms or loss of biodiversity.

***Flexible infrastructure.*** Green infrastructure provides a community with choices such as installing green roofs, rain gardens and swales throughout the urban landscape in order to slow and retain stormwater and preclude the need for additional pipes or treatment plants. Green infrastructure is also often a fraction of the price of structural infrastructure. Take for example the wetland and water reuse system in Clayton County, Georgia. This natural system proved far less costly than an advanced treatment plant while also providing water supply benefits. The savings from natural infrastructure projects provide communities with greater financial flexibility to continue adapting their infrastructure to changing conditions, which in turn allows them to minimize damages and recover from disasters. In an era of economic uncertainty, declining tax revenues and growing budget deficits, this flexibility is essential to small and large communities alike.

***Strengthening Local Economies.*** The economic consequences of a changing climate are difficult to predict, but there is no doubt that the impacts will be significant. Locally, the impacts could be greater depending on the economic industries that support a community. The strength of local economies is undoubtedly closely intertwined with the overall well-being of communities. Reducing the vulnerability of key industries to climate change and water impacts while limiting local government service expenses can help protect and boost local economies.

***Achieving Multiple Benefits.*** Water management strategies have benefits that extend far beyond their primary goal. In addition to controlling stormwater, green roofs lower ambient air temperatures, decrease heating and cooling bills and improve air quality. These multiple benefits address the immediate needs of a community such as unhealthy levels of air pollution, poor water quality and deteriorating infrastructure in addition to building resilience to the impacts associated with rising temperatures. On a pragmatic level, these multiple benefits can be a primary motivating factor for local leaders that have limited resources to deal with what they perceive as more immediate and tangible problems than climate change.[6]

**Conclusion**

Incorporating ecological resilience as a goal of floodplain management is critical to protecting people and their environment in a world where the climate is changing, growth is increasing, and costs of addressing these challenges continue to rise. We know that increasing the positive relationship local communities have with the river will help to promote change at the local level.[7] I argue that building resilience can help to reinforce and increase the positive relationship communities have with their river. Resilience can help reinforce the sense of predictability and the sense of connectedness to the river through feelings of pride in a sustained ecosystem, possessiveness of a strengthened economy, protection of the river through green infrastructure, and practicality of receiving multiple benefits.

## Endnotes

1. *See* Tockner, K. and S.E. Bunn, C. Gordon, R. J. Naiman, G. P. Quinn, and J.A. Stanford. 2008. Flood plains: critically threatened ecosystems, at p.53. Aquatic Ecosystems, ed. N. Polunin. Cambridge University Press. Foundation for Environmental Conservation.
2. *Ibid,* at p. 55.
3. *Ibid.* At p. 24.
4. *See* Natural Security: How sustainable water strategies are preparing communities for a changing climate. By Will Hewes and Kristen Pitts, American Rivers 2009.
5. *See* B. Freitag, S. Bolton, F. Westerlund, and J.L.S. Clark. 2009. Floodplain Management: A New Approach for a New Era. Island Press, Washington, DC. At p. 23.
6. *See* Gamble, J.L. et al. 2008. Analyses of the effects of global change on human health and welfare and human systems. U.S. Climate Change Science Program: Washington, DC.
7. *See* April 2009 report: *Reasoning Patterns about Flooding: Cognitive Analysis of Focus Groups conducted in Davenport, Iowa, and Rock Island, Illinois* by John Whaley and Pamela Morgan with American Environics and Ruth Bernstein with EMC Research on behalf of Institute for Business and Home Safety and American Rivers.

# FLOODPLAIN MANAGEMENT NEEDS A CONSERVATION ETHIC

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The floodprone areas of the United States are finite land-and-water systems that have specific natural functions and accompanying resources. These functions and resources are vital to human existence and also to the ecological balance of the planet. The tension between the needs of the ecosystem and human demands threatens this vital but exhaustible resource base. Unfortunately, that simple set of facts is barely recognized in contemporary floodplain management policy and practice.

**Some Perspective**

In the 1960s and 1970s, national policy advances were made that provided a glimpse of the interconnections among floodplains, wetlands, and environmental objectives. The U.S. Water Resources Council pointed out that floodplains had "natural and cultural" resources (U.S. Water Resources Council, 1979) and their importance was emphasized in each subsequent edition of *A Unified National Program for Floodplain Management* (Interagency Task Force on Floodplain Management, 1986; Federal Interagency Floodplain Management Task Force,1994) and given prominence in a subsequent national report devoted solely to floodplain functions and services (Task Force on the Natural and Beneficial Functions of the Floodplain, 2002).

However, with the exception of the limited protection provided to wetlands (but not to entire floodplains) under the regulations of the Clean Water Act, little has been done to further a national policy that acknowledges—and safeguards--the role that natural floodplain functions and resources play in our nation's future well-being. That well-being depends on public safety, an economically stable resource base, high quality of life, and the simple knowledge that abundant, healthy floodplains continue to exist in our landscape and support our ecosystems.

Now in 2009—before it is too late—we must foster a natural resource conservation and management ethic within floodplain management. As a policy, floodplain management needs a mature and balanced embrace of life safety, the built environment, and the value and condition of our floodplains' natural resources. As a discipline, floodplain management must reach beyond engineering and planning to embrace the science and expertise of natural resource management.

**A Rationale for Action**

There are many reasons to preserve the natural resources, functions, and services of our floodplains. Perhaps most persuasive is that a nation's natural resources are its economic underpinnings. A nation must have a resource base to clothe, feed, and provide raw materials

for the production of necessary material goods for its population and to generate a sustainable national economy.

Almost 30 years ago, Dasgupta and Heal (1980) called attention to the fact that, in contrast to the theories of previous centuries, 20th century economic theory failed to consider the limits that natural resources could place on an economy. Not did it make explicit the underlying assumption that slight price fluctuations could counteract any negative impacts on the resource base. In essence, society's perception of an abundance of natural resources had created the illusion of an unlimited supply—an illusion that carried into economic theory.

Today, one only need look at the status of our nation's water resources and floodplains to realize that much of our infrastructure and investment took place on the basis of these flawed economic theories and misperceptions. A short-sighted policy evolved during two centuries of desire to expand the human footprint on the continent by leveraging land and water resources to establish the nation's economic dominance. A long-term resource conservation strategy has been missing. Instead, water resource economics and policy has been focused primarily on a fairly quick financial return on developed uses. Little, if any, accounting has been made of the lost opportunity costs to the nation brought about by the demise of critical floodplain resources and functions— natural habitat, aquifer recharge, water filtration, flood storage and conveyance, open space and aesthetic pleasure, contribution to biodiversity and watershed health, and others. Flood protection programs of the federal government, by policy mandate, must maximize the national economic development (NED) return on any investment. Authorizations for many of these programs come from the Water Resources Development Act.

Because of the historic perception of limitless resources, a narrow focus on economic development, and laws to support these perspectives, it is not surprising that current policies and programs reflect a bias towards protecting developed—rather than natural—uses for floodprone areas. Nor is it a puzzle that accepted water project analyses are virtually incapable of demonstrating a flood loss reduction benefit for open space or natural resource conservation or accounting for the costs of degraded or diminished resources.

Today, however, we do have the choice—and the responsibility—to manage both finite and renewable land-and-water resources as well as renewable resources in a manner that is sustainable.

**Forestry and Agriculture as Analogs**

There are examples in history of a national shift from an "extraction" to a "sustainable management" mindset. The deforestation of the late 1800s and the dust bowl of the 1930s brought into focus just how fragile our seemingly unlimited resources were, along with a recognition that change was needed. It became clear that, if we did not modify the way in which we managed these resources, we would ultimately lose the ability to produce food or supply forest products essential to people and to the economy.

Today we face similar challenges with the natural resources of our floodprone lands and their water. Fresh and saltwater fisheries are in decline. Water supplies are at the brink of snapping due to oversubscription accompanied by a contradictory need to provide for a rapidly growing population. Many flora and fauna are stressed and the long-term impacts of that stress are unknown. A changing climate will only further strain these and other resources.

Prolonging a national flood "policy" that does not fully consider the value of these and other resources—to practice floodplain management in a manner that does not embrace a conservation ethic—would be akin to our nation's having turned its back on the deforestation of the late 1800s, or to having failed to change agricultural practices during the 1930s.

## To Move Forward

If floodplain management does not embrace a natural resource ethic on a nearly universal basis, we risk responsibility for the collapse of our water-based biotic systems with potentially disastrous impacts on our economy, our well-being, and our future. Changes in at least four categories must be made to effectuate such an ethic, outlined below.

**Policy—**We need to evaluate fully our water and associated land management policies to ensure that all practices are aligned and that they give due consideration to the natural functions and services of floodplains. To date, our primary strategy has been that of environmental regulation, which, as conservationists know all too well, essentially means presiding over the orderly demise of these systems, rather than preserving or managing them.

**Practice—**Broad goals such as "protect and restore" the natural resources and services provided by floodplain lands (as declared in numerous official documents) are all well and good but carefully targeted direction is needed. Without measurable goals we cannot ensure for future generations any semblance of the natural riparian and coastal resources that characterized our continent for millennia.

Several methods are available in the natural resources field to quantify the services, functions, and resources provided by lands in their natural or nearly natural condition. Some of these are ecosystem valuation (see, for example, King and Mazzota, 2000); economic impact analysis (see, for example, Rivers, Trails and Conservation Assistance Program, 1995); ecological risk assessment (see, for example, Suter, 2006); and benefit/cost analysis (see, for example, Kroeger and Manolo, 2006). These methods, and others, need to be applied to floodplain resources and services in order to make wise decisions, craft management targets, and assess progress. This approach has been used for floodplains only in isolated instances (see, for example, Riley, 2009; and Swedeen and Pittman, 2007).

**Education—** Floodplain management professionals of the future should include planners, biologists, natural resource managers, engineers, and many others. Today's managers should be challenged to obtain additional formal or informal training in natural resource management practice and its theory.

**Vision—** The nation needs to enunciate a vision of our land-and-water resources for the 21st century and beyond that reflects all of our new realities— population growth and movement, advanced technology, changes in climate, increasingly dense (and expensive) development and infrastructure, and, finally, the combination of all of these. We are no longer a nation whose lands and waters are unlimited compared with our large and growing population. However, we do still have a wealth of these resources that can be sustained, given the necessary attention and management.

## To Sum Up

Any national strategy for managing flood-prone lands—whatever term is used to describe it—must fully incorporate both the risk of flooding (threats to the built environment and to lives) and risks to the floodplain (threats to the resources and functions that depend on natural flood-prone areas). To accomplish this we must allow room for these parallel objectives in our thinking and also work towards establishing a resource conservation ethic within our practice and within our policies. Failure to do so will likely lead to further division between the co-equal objectives of floodplain management (loss reduction and resource protection) and further erode the real underpinning of our nation's economy—a healthy base of water-related natural resources.

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# RESTORING WETLANDS AND PROTECTING NATURAL HYDROLOGY—MUSTS FOR FLOOD RISK REDUCTION

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Increasingly, programs at federal, state and local levels for watershed and wetlands protection and restoration have aligned with the goals of flood risk reduction. What is good for water quality and habitat is generally also good for restoring and preserving floodplains and reducing floods and flood risk. Among the imperatives for flood risk reduction are: protecting and restoring wetlands; replicating natural hydrology on the landscape, reconnecting rivers and streams to their floodplains, and identifying, preserving and reconnecting high quality and high value green infrastructure. If we could meet these goals, generally speaking we would not only reduce flood risk, but also would improve surface water quality and aquatic and terrestrial habitats.

The Federal Interagency Floodplain Management Taskforce's 1994 report, *A Unified National Program for Floodplain Management*, and ASFPM's 2008 policy paper, *Natural and Beneficial Functions: Floodplain Management – More than Flood Loss Reduction*, both convincingly described that reduction of loss of life and property caused by floods, and protection and restoration of the natural resources and functions of floodplains are co-equal goals and that public policy should be aligned to achieve both. Two necessary features of a new flood risk policy are restoration and protection and wetlands, and preservation of natural hydrologic function in a post-development landscape.

**Protect and Restore Wetlands**

Wetlands are a critical natural feature on the landscape. Among the many important ecological functions of wetlands is their remarkable ability store water. Wetlands function like bathtubs, storing floodwater and releasing it slowly over time. In this way wetlands help protect adjacent and downstream properties from flooding. Eighty percent of the Nation's wetlands are located in riverine and coastal floodplains making them an important component of floodplain management. Yet, through a combination of ignorance and public policy that favored development over natural resource protection, over half the wetland acres in the United States have been lost since colonial times. Continued wetland loss contributes to the ever increasing flood risks in the United States and wetland loss in coastal watersheds in the U.S. continues at a rapid pace.

A stark example is the dramatic loss of forested wetlands of the Mississippi River Alluvial Plain. Over the past two centuries the extent of bottomland hardwood forests in the region has decreased from 24 million acres to less than 5 million acres. (The Nature Conservancy http://www.nature.org/wherewework/northamerica/states/louisiana/preserves/art6867.html).

It has been estimated that over 60 days of floodwater storage once existed in the bottomland hardwood forests along the Mississippi River, but due to the dramatic loss of these wetland forests, only 12 days of storage remains today. (Ducks Unlimited http://www.ducks.org/Conservation/Habitat/1542/IncreasedFloodStorage.html). The loss of flood storage in the Lower Mississippi River Valley has contributed to an increase in flood heights downstream. Levees and man made channels keep floodwaters from spreading out into the floodplain and increase river levels and flooding downstream. Much of the Mississippi river system floodplains are no longer able to perform their natural functions during flood events, contributing to increased overall flood risks.

Coastal wetlands continue to be in decline. The 2008 coastal wetlands report by NOAA and USFWS found that from 1998 to 2004, wetlands in coastal watersheds in the Great Lakes, Atlantic and Gulf coasts have experienced an average net loss of 59,000 acres annually (http://www.nmfs.noaa.gov/habitat/habitatprotection/pdf/wetlands/WetlandsReport_012909.pdf ). In addition to being the nurseries for important commercial and recreational fish and vital habitat for many threatened and endangered species, coastal wetlands also provide natural protection for coastal areas from the most damaging effects of hurricanes and storm surges. The NOAA and FWS findings point to the need for an expanded effort to conserve and rebuild valuable wetlands in our coastal watersheds.

Better protection of wetlands throughout the county is essential to reducing flood risks and this is particularly urgent in our Nation's coastal watersheds.

**Replicate Natural Hydrology on the Landscape**

Encroaching development, with its clear cuts, fills, paves, and placement of levees in floodplains, reduces natural and beneficial functions of floodplains, including flood mitigation. This puts new and existing development at increased risk. Aggravating this problem are development practices in uplands. As forests and grasslands are replaced with impervious surfaces such as buildings and pavement, stormwater that used to infiltrate into the ground, restoring groundwater supplies and providing stream base flows, now runs off in large volumes, often through concrete curb, gutter and storm drain systems designed to speed its pace into the floodplains and streams. The engineering techniques used by past generations focused mainly on draining water off a property as quickly as possible, conveying it by pipes to the nearest stream at an increased volume and rate. The resulting effects repeated ubiquitously in developed areas include: increased erosion and sedimentation that chokes our rivers and estuaries with pollutants; widening and deepening of stream channels that continues to get worse; permanent alterations to the hydrograph and to natural stream channels that once provided rich habitat, improved water quality and flood mitigation; and untold miles of property damage.

We now know, from decades of study and observation, that the problem of damaging stormwater volumes and rates caused by development can be cost-effectively addressed through "Low Impact Development" design techniques.

In Low Impact Development, stormwater is managed close to where it falls, rather than being collected and conveyed for management. The principal design goal of LID is to retain the natural hydrologic functions of undeveloped land through techniques that retain, store, harvest and re-use or evapotranspire stormwater on site. Stormwater engineers, working with multidisciplinary teams including landscape designers, planners, and soil specialists, have developed many practices that can be used to fit virtually any site. These practices include permeable pavements that allow rainwater to flow through the load-bearing surfaces of parking lots and roadways; bioretention (also known as **"**rain gardens**"**); and practices as simple as using roadside swales with native grasses instead of concrete-lined channels. In highly urban areas, practices often include green roofs and other forms of "functional landscaping."

These techniques are very simple in concept, and have been shown to reduce runoff volumes significantly. Used on a wide scale, they can reduce annual runoff volumes up to 80 to 90 percent or more. That also means reducing pollutant loading by up to 80 to 90 percent and significantly reducing stream scouring. The effectiveness depends on the rainfall pattern of the region and the designs used.

Fortunately, the engineering, planning and design communities together with local governments, and state and federal stormwater management agencies are embracing LID and the prospects are rapidly improving for widespread implementation. One example at the federal level is the requirements in the Energy Independence and Security Act of 2007. While the bulk of the Act focuses on energy issues, Section 438 of the Act requires Low Impact Development be used as the default design practice for stormwater management for Federal facilities. Now when Federal buildings or parking lots are constructed, they must manage their stormwater runoff so that the predevelopment hydrology of the site is maintained. No more runoff can leave that site than would have done so under predevelopment conditions. Predevelopment conditions are the native land conditions such as forests and grassland. To assist each federal agency or department responsible for ensuring compliance with EISA Section 438, in December 2009 EPA released *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act* http://www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf. It is a state-of-the-art technical guidance on the next generation of stormwater management practices increasingly employed by many cities, counties, states, and developers today.

**Conclusion**

Naturally functioning and abundant floodplains and wetlands reduce flood damages while at the same time advancing water quality management goals. Natural hydrology on the landscape also reduces flooding and protects water resources. Restoring and protecting these natural aquatic and hydrologic functions on the landscape is a critically important public policy goal for reducing flood risk, and vital to the success of any new flood risk reduction policy.

# MANAGING RISK TO HUMANS AND TO FLOODPLAIN RESOURCES

**Sandra K. Knight**
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This shouldn't come as any surprise: hazard mitigation is one of the toughest jobs there is. Because if it were as simple as telling people they are at risk for something, giving them some tools to manage that risk and then them actually doing it, we could all eventually call it a day and go home. But over the years we've learned, in many cases the hard way, our job is not so simple or straightforward.

We all know that nature brings threats to life and property. And that only a shared investment can strengthen our ability to withstand those threats.

We also know that every dollar invested in mitigating risk pays off four-fold.

But there is an ever-widening gap between convincing an individual or community that they are at risk and convincing them to take some action to reduce that risk. Therein lies the age-old dilemma we face. I can promise you that there is no silver bullet here. Perhaps though, a different way of looking at this challenge is a step in the right direction. Or maybe we can steal some good ideas from a similar movement.

All communities face risks of various types. For some it is economic: job creation, industries coming or going, crime, schools or other public services, poverty, homelessness, blight. For some it is from a natural hazard: a levee break, a flood, a fire, tornados, earthquakes. We all have too many competing priorities and too few dollars to do everything we need to do. As professionals who focus our efforts on long-term community resiliency and sustainability, we recognize that flood hazard reduction may not rise to the top of the list given the scores of other, more immediate, priorities. That doesn't mean we give up the fight, throw in the towel, and walk away. It means that we need to look at the battles we can win instead of the war which seems unwinnable now.

We recognize, that, as a Nation, our collective memories regarding disaster is short. This year marks the fifth anniversary of Hurricane Katrina in the Gulf Coast. While much has been rebuilt in the last half-decade, much work remains. Immediately following the storm there were great cries from across the Nation to rebuild smarter, stronger, safer. We vowed that the lessons of Hurricane Katrina – continued development in known high-risk areas among them – should not be forgotten. Yet political and economic pressures, as they sometimes do, won out in some areas. And mistakes of the past will again become recovery missions in the future. And most of the rest of the country, despite our best intentions, moved on.

As I write this, the cable news channels still breathlessly report every tidbit of news from the Haitian earthquake response and recovery. I'm guessing that by the time you read this, CNN and MSNBC and Fox, like the rest of America, will have moved on to something new as well.

So our memories are short unless we're directly affected by an event. And in most cases, thankfully, we're not. Throughout my 30-plus year career, first in the U.S. Army Corps of Engineers, then at the National Oceanic and Atmospheric Administration, and now at FEMA, I've been witness to countless floods, fires, hurricanes and other disasters. I frankly stopped counting many years ago how many. Some stand out in my mind because of their scope, but many are relegated to deep in the memory banks.

Such disaster amnesia is a normal and perhaps even healthy way of dealing with the tragedies we see others experience. But it doesn't make our jobs communicating and convincing to act any easier.

We're also challenged by will.

I wish it weren't true, but there are countless communities and leaders today who refuse to accept and address their risks. They consciously choose to ignore risk data and science and some may even use political pressure and the media to fight the facts – just enough to confuse people and enable themselves to continue risky behaviors to avoid the inconvenience or costs of facing and managing their risks.

I certainly understand that there are tough choices to be made when facing risks to flooding or other hazards, but ignoring the risk factor has a big price tag and long-term consequences. Unfortunately, some communities continue to make risky choices even when they know the choices may mean eventual devastation.

Creating that will requires a culture change, but such changes can and do occur. That will exists -- despite inherent costs -- when it comes to other initiatives, especially those which are seen as more cool. In 2006, Vanity Fair magazine trumpeted that "Green is the new black," which made being an environmentalist suddenly cool again. It is worth noting that the first Earth Day was 40 years ago this April and that America's love affair with "being green" has ebbed and flowed since then.

But now, corporate and government "sustainability" and "green initiatives" are the must-have buzzwords found in every C-level meeting. Investments in the green economy, even in these otherwise austere times, are being made. Like it or not, decisions are being made from City Hall to the White House to enhance sustainability – from combating global warming on a macro scale, reducing our reliance on foreign oil on a national scale, to saving a rare and endangered species on a very micro scale.

For a moment, let's leave behind the politics of this movement and just look at the success of it. So what did the Green Movement do so well? What lessons can we take from it? Or can we add on to it?

If you step back in time, you might look at Henry David Thoreau as one of the first true "environmentalists" or maybe Teddy Roosevelt, or maybe it was those who created our National Park System to preserve spaces deemed national treasures. It could easily be argued that the original inhabitants of North America, the Native Americans, were the first environmentalists, learning to live within nature rather than trying to command it.

Regardless of who was first, American environmentalism has a very long history and been at times very controversial.

The modern green movement has its roots in the 1960s with the publication of Rachel Carson's "Silent Spring", the passage of the Wilderness Act of 1964, the creation of the Environmental Protection Agency in 1970. Throughout the 1970s numerous steps were taken to clean up the environment including the National Environmental Policy Act, the Clean Air Act, the first Earth Day 40 years ago, the banning of DDT, the Water Pollution Control Act, and the Endangered Species Act. While there was significant backlash by industry against environmental regulation, the various Acts were not overturned.

But they still weren't what most people would call "cool" in the 21st Century. Now "cool" is Brad Pitt driving a hybrid, Leonardo DiCaprio using low-emissions paint, Sting working on behalf of rain forests, and Willie Nelson producing bio-diesel fuel made of used French-fry oil for sale in Texas truck stops.

Many of us, myself included, carry our reusable grocery bags to the supermarket and we're slowly replacing our old incandescent light bulbs with more energy efficient fluorescents.

We've been goaded and guided and even guilted into thinking that we're better humans because we're more environmentally conscious.

It's time for us to learn from the successes of the green movement and begin to reframe the dialogue on risk and resiliency. Communicating risk isn't about forcing people to buy flood insurance or limiting a community's ability to exercise home rule over development. It's about equipping communities with the tools they need to make informed choices about where and how they develop.

At the federal level, at FEMA, we're starting to re-frame that dialogue. We're no longer just explaining the risk, and what can be done to reduce it. We're talking about the opportunities, and the consequences. But we can't do it alone. We need multiple champions at every level who are willing to step out and talk about community resiliency.

It's our job as leaders in building resiliency and sustainability to ensure that our voices are heard when we say, "We must get smarter about how and where we build our homes, our businesses and our public facilities. "

Our President has made it clear that a principal goal of this administration is to ensure a more resilient Nation. One in which individuals, communities, and our economy can adapt to changing conditions as well as withstand and rapidly recover from disruptions due to natural disasters.

On September 4th, 2009, at the start of National Preparedness Month, President Obama underscored the responsibility of individuals, families, and communities -- *including the private and nonprofit sectors* -- to do their part before an emergency, emphasizing the responsibility we all share for working side-by-side within our communities to safeguard or homes and Nation from harm. The Administration's message of partnership in disaster preparedness and mitigation could not be clearer.

Recently, in a document developed by the National Emergency Management Association and FEMA, it was stated that "No single agency or level of government, sector of business, or individual community can achieve successful mitigation on its own." We need to embrace the reality that we are all in this together. Recognizing the limitations of our individual organizations and the remarkable advantages of collaboration, encourages us to work together as a community of partners to identify, implement and evaluate the effectiveness, of disaster mitigation programs and policies.

We also need to recognize that the traditional community of mitigation partners has not always included the community leaders or citizens that will have the most influence on the success or failure of those programs and policies. Local governments often have the lead responsibility for implementing the strategies we develop, and very often they differ on both what the real challenges are, and what the solutions should be. It is precisely because of their differing viewpoints and skepticism, that their partnership is essential to a comprehensive dialogue on disaster mitigation. Partnering with community leaders and citizens to identify mitigation needs and solutions often results in the services or assistance provided by government or private sector partners, being rightly interpreted as satisfying community needs, rather than acts of dictation or enforcement.

The resulting resiliency and sustainability activities become *shared investment*s, in which all partners have a stake. Creating resilient communities that are able to not only survive disasters, but come through them safely, quickly, and securely, requires this type of shared investment. Families, communities, States, private sector organizations, and the Federal government all must devote the time, energy, money, and human capital to necessary to achieve and sustain these types of shared investments.

And a shared investment means more than several organizations investing in a single effort or initiative, it means investing in one another. Within FEMA's Mitigation Division and the National Flood Insurance Program we continue to do all we can to foster a culture of reducing our vulnerability to natural events. But we cannot do it alone. We cannot do it without the leadership of policymakers from all levels who recognize that we live on a restless planet. And we must not ignore that the technology and resources exist to enable Americans to build safer, stronger, smarter and more resilient to natural events.

Until messages about protecting yourself from disasters are as common as messages about the hazards of drunk driving and the value of smoke detectors, meaningful change will be hard to come by. And until laws are adopted at all levels instituting a culture of community resiliency and sustainability, we'll never be completely safe.

America needs a top-to-bottom commitment to disaster resiliency – to make it "cool" to be a mitigator. This movement toward resiliency will require a national framework with representation and commitment from traditional players like academia, associations and agencies and new partners like the private sector and government at every possible level.

The front line in this movement to convince America on the value of mitigation begins on Main Street. It is the people in communities -- whether leaders, or those who vote for leaders, or those who buy their products -- who are ultimately accountable for community resiliency. And it's there that the culture of mitigation must have its birth.

# LOCAL RESPONSE TO A GLOBAL CHALLENGE— HOW COMMUNITIES PREPARE THE NATION FOR CLIMATE CHANGE

**Sam Riley Medlock**
***Association of State Floodplain Managers, Inc.***

If world governments agree today to adopt measures to eliminate greenhouse gas emissions tomorrow, the projected residual increase in global warming will continue to alter climate worldwide for generations to come.[1] Many of the observable and anticipated impacts of climate change revolve around water: its supply, its uses, its flood risks.[2] Just as communities that prepare for a flood fare best when the waters rise, communities that adjust their policies and practices to adapt to a changing climate stand the best chance of surviving and thriving when those foreseeable changes impact them. This paper lays out key findings regarding climate-related flood impacts, identifies vehicles for the development and implementation of adaptation planning, and identifies areas for further policy exploration and innovation.

Although developed nations began adjusting water policies and governance frameworks decades ago, the United States still lacks a unified national policy or law to prepare Federal systems to meet today's climate challenges. In fact, States and local governments have served as the laboratories for policy innovation through a growing body of statutes, ordinances, and systems of incentives to encourage sustainable practices and more resilient development.[3] Although many models exist of State and local climate adaptation planning, many States and communities are only now considering whether and how to factor climate adaptation into their planning and regulatory regimes. While more than 30 States are taking action to reduce their emissions of greenhouse gases, only 10 are in the process of developing State adaptation plans.[4] The rest are playing the waiting game – gambling with their constituents' livelihoods and lives that climate impacts will pass them by unharmed.

**Climate change is occurring and communities are already experiencing the effects of a changing climate.** The best available observational evidence from long-term monitoring networks indicates that climate change is occurring, although the effects differ regionally.[5] Summarizing the most recent data, the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment states:

> Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas.... Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s.[6]

Additionally, water cycle disruptions will affect inland waterways, resulting in changes to precipitation intensity and more frequent flooding and drought. The US Global Change Research Program summarizes:

> Climate change impacts include too little water in some places, too much water in other places, and degraded water quality. Some locations will be subject to all of these conditions during different times of the year. Water cycle changes are expected to continue and will adversely affect energy production and use, human health, transportation, agriculture, and ecosystems.[7]

Increased ocean temperatures not only lead to sea-level rise but to an increased risk of damage from storms. A large proportion of the financial losses fall in urbanized areas because of the high value and large amount of infrastructure at risk.[8] Moreover, the IPCC has concluded that it "is *very likely* that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent."[9] These changes carry clear implications for floodplain managers as "heavier precipitation in tropical and inland storms will increase the risks of flooding, expand floodplains, increase the variability of streamflows (i.e., higher high flows and lower low flows), increase the velocity of water during high flow periods, and increase erosion."[10]

If we proceed on the assumption that risk is the product of probability and consequences, or R = P x C, then we can break down the anticipated effects of climate change on the risk equation. Since disruptive climate impacts are already underway and anticipated to increase,[11] climate impacts can be reasonably foreseen to increase the probability of flood events due to increased frequency in some regions, resulting in a net increase in risk, even if consequences remain stable. However, development patterns confirm that consequences are also rising due to the continued settlement of areas of risk to coastal and inland flooding, accelerating rates of investment in costly infrastructure that further attracts development.[12]

**Communities are the first and last line of defense against the harmful impacts of climate change.** Although the Federal government plays an important role through making data and funding available to support decision-making, development planning and permitting is performed by States and, most often, local governments. Additionally, the success of Federal and State requirements for planning to address hazards often depends upon incorporation into local comprehensive land use plans, and upon implementation through local land use planning, zoning, codes enforcement, permitting, and inspection. States have largely delegated to local governments through the police power the authority to enact ordinances and regulations designed to protect the public health, safety, and welfare.[13]

Protecting residents from various natural hazards has long been a fundamental value and objective of local land use control. Despite the burgeoning Federal disaster relief environment, courts have long recognized the duty of local governments to manage foreseeable hazards, and have held them responsible for failing to meet this duty.[14] Since communities are recognized by States, courts, and their constituents as having the authority to control land use and the responsibility to identify and manage risks associated with flood hazards, communities need to incorporate climate adaptation into their planning and regulatory frameworks, even though precise data about climate impacts are still being developed.

Economists broadly agree that uncertainty about the precise causes, extents, and impacts of climate change is not an excuse for inaction. As Thomas Schelling notes,

> [T]his idea that costly actions are unwarranted if the dangers are uncertain is almost unique to climate... In other areas of policy, such as terrorism, nuclear proliferation, inflation, or vaccination, some 'insurance' principle seems to prevail: if there is a sufficient likelihood of sufficient damage, we take some measured anticipatory action.[15]

Nobel Laureate Kenneth Arrow suggests that we should take uncertainties into account by basing our policies on anticipated harm about 50% higher than the median expected harm, in order to account for the element of risk.[16]

Observational and predictive capabilities are being improved and used to create tools to help support decision making at local, regional, and national scales to cope with environmental variability and climate change.[17] More data are being scaled and made available to regional and local government planners to support improved decision-making. As more data identify areas of current and future risk, planners can make better informed decisions regarding mitigation of risk to existing development and the siting of future growth.

The existing panoply of planning tools and techniques can be used to prepare communities for climate change. These include the comprehensive land use plan, zoning and land use regulations, and open space preservation and acquisition of areas of risk.[18] Additionally, local leaders are engaging stakeholders across sectors, disciplines, and levels of government to develop policies and best practices to address current and projected climate impacts. These activities include, among many:

1. Adoption of long-range plans for strategic withdrawal from areas of anticipated risk, while reviewing proposed development and redevelopment for consideration of climate impacts, and alignment with the community long-range plans;
2. Studying key industries and employers through public/private partnership to evaluate commercial sector vulnerability to climate impacts;
3. Engaging in integrated water resource planning to consider water quality, supply, and flood risk issues in a holistic approach;
4. Formation of watershed and other regional working groups among leaders of communities that share a basin, aquifer, or other interest to develop relationships, share ideas, and develop regional adaptation plans;
5. Collaboration with environmental resource managers to assess and plan for natural resources adaptation;
6. Generation and sharing of data (streamflow, groundwater, precipitation, and others) to support analyses;
7. Engaging the public health community to better inform hazard mitigation planning with understanding of infectious disease, thermal stress, water supply, and other public health factors;
8. Collaboration with stakeholder groups and NGOs to identify social impacts, leverage planning, and improve public engagement.

However, areas for further policy exploration and innovation include the following:

1. Mainstreaming adaptive planning into the routine policy and decision-making processes.
2. Adaptive management will need to—well—*adapt* to changes in data and risk delineations as more precise analyses become available. This will require continuous monitoring and dissemination of scalable impacts forecasts to local planners and other public officials.
3. As data improve, courts will increasingly look to local officials to anticipate and prepare for foreseeable impacts to climate change, resulting in possible new liability frameworks.

Ultimately, we as risk managers are best equipped to prepare our communities for the changes to come. Adaptation planning depends on the active engagement of numerous stakeholders across disciplines, sectors, and levels of government. While many efforts address the mitigation side of the climate equation, reducing emissions to slow the rate of climate change, local governments must heed the call to adapt to changes that are already underway.

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# NATURAL AND BENEFICIAL FLOODPLAIN FUNCTIONS: FLOODPLAIN MANAGEMENT—MORE THAN FLOOD LOSS REDUCTION


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With the passage of the National Environmental Policy Act over three decades ago, the United States established a foundation for protecting the environment amidst human development. In Section 101 of the Act, Congress declared that

> . . . it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

However, the reality is that we seldom achieve this "productive harmony" with regard to our rivers, streams, wetlands, and coastal lowlands. As we move into the new century, we face hard choices about our riverine and coastal floodplains. Relatively unfettered economic development, with only a token allowance made for floodplain functions and resources, cannot continue as the status quo. Instead, we need to strike a balance between development and the benefits that would be realized if we were to protect the natural functions of floodplains and coastal areas.

Current floodplain management in this country has twin goals: (1) flood loss reduction, and (2) the conservation and protection of the natural and beneficial functions of our water resources. Although considerable effort has been expended on the first goal (with mixed success), the second has received only minor consideration. Until recently, activities that protected or improved the natural and beneficial uses of floodplains usually were only planned or executed as afterthoughts, or were included in a project only because of a regulatory requirement to mitigate the environmental impacts of another project. The restoration or rehabilitation of a waterway, coastline, or its related resources was rarely considered a project worthy of funding or of being undertaken on its own merits.

Amid significant alteration of our major waterways to optimize commercial benefits and in the name of flood "control," flood losses have continued to rise each year. At the same time, environmental degradation, particularly of water-related resources, has increased, and anticipated changes in climate bring the potential for significant alteration of existing coastal areas, flood regimes, and already fragile ecosystems. We need to marshal unprecedented forces to preserve and improve the natural functionality of our floodplains and coastal areas and protect the resources they provide. In doing so, we will also mitigate damage and losses that floods bring to society.

This need is urgent. In the next 20 years the U.S. population is predicted to increase by 80-90 million people, a huge increase over the current 300 million. The added population will increase

* This paper is based on a White Paper prepared for the Association of State Floodplain Managers.

pressure to continue to allow development adjacent to the nation's water resources. Paradoxically, that population will still expect the nation's flood risk to be minimized and will demand additional open spaces and natural areas. We need to remember that we have a choice not to occupy our river floodplains and coastal areas and that, if we choose to do so, there is a very real cost associated with the degradation of these water resources—a degradation that is the inevitable byproduct of our occupation of these areas.

Management of floodprone areas has for too long been development-centered. The typical strategy has been to confine the waterway or water body to a predefined size and capacity that maximizes the extent of developable or agricultural land and also keeps the flood water away from people and their property. Under such a framework, the floodplain served a singular, human-centered role as a conveyance network to pass the "excess" water as quickly as possible, with no consideration of the loss of ecological function, the potential damage to downstream property owners, or the cultural, economic, or environmental effects of that strategy. Further, floodplains have been viewed as suitable sites for human development; the concern, if any, has been to ensure that structures built there are elevated above some minimal flood level, so they are considered "safe," and also to insure them. In coastal areas, the typical approach has been to place development, especially residences, as close to the water as possible and then, if necessary, to use structural measures to prevent the beach from migrating away.

In many cases, the communities responsible for these decisions about growth, development, and flood protection possess a minimal understanding of the natural processes that take place in riverine and coastal areas and lack adequate tools to deal with the flooding issues they face. Floodplain management decisions often are made outside of the context of regional or watershed-level planning and without appreciation of the complexities of the water-based ecosystem. Hence, as recent flood disasters and their aftermath have indicated, communities often respond to such disasters by applying more of the same techniques that caused or exacerbated the problem in the first place. Increasing flood losses and environmental degradation have made it clear that the floodplain cannot be viewed simply as a conveyance channel to keep water away from people. Nor can we continue to implement flood damage reduction measures without considering impacts to riparian and coastal ecosystems.

Flooding is a natural process that forms and maintains floodplains and coastal zones. Periodic flows of water that overtop the banks of a river and that encroach upon coastal areas are the lifeblood of the riparian corridors, marshes, beaches, and other natural areas. The seasonal variability of flow, incessant wave action, and intermittent extreme events all combine to determine both the physical structure and the biological diversity of floodprone areas. Successful, sustainable flood hazard reduction solutions need to be based on the forces at work in floodplains and coastal zones and also on the resources that these floodprone areas provide. These processes and attributes can be categorized as (1) hydrologic and hydraulic processes, (2) geomorphic processes, and (3) biologic processes. These processes have interrelated functions, which in their natural state provide numerous resources and benefits to society.

Flooding from hurricanes and storms is the key process in providing such tangible benefits as increased soil fertility, wetland creation, rejuvenation of spawning gravel, creation of barrier islands, promotion of aquatic habitat, transportation of large woody material that provides fish habitat and bank stability, promotion of plant establishment, and the evolution of channels and shoreline features such as dunes. These resources are described in detail in numerous documents, notably *A Unified Program for Floodplain Management* (Federal Interagency Floodplain Management Task Force, 1994) and *The Natural & Beneficial Functions of Floodplains* (Task Force on the Natural and Beneficial Functions of the Floodplain, 2002).

Naturally functioning riparian and coastal areas are the product of a tightly interconnected system of all of the Hydraulic, Geomorphic and Biological processes.. The ecosystems sustain themselves by means of these ongoing processes. Human activity, especially urbanization and alteration of the flooding process as a means of controlling and/or storing water, interrupts these natural processes and thus disturbs the functions and overall health of the ecosystem. Attempts to transport runoff and flood waters efficiently through the watershed, we have used structural interventions (such as concrete lining, revetments, floodwalls, jetties, diversions, and dams and reservoirs) that interrupt or modify natural hydrologic, hydraulic, geomorphic, and biologic processes. The ground surface and natural vegetation are disturbed during construction. The structures change the natural movement of water in one or more ways such as altering the speed, restricting movement across the floodplain, and changing sediment loads. Floodwalls and levees increase flow discharge and elevation when they constrict high flows into a narrow path. Land use policies that allow encroachment into the floodplain can cause dramatic channel migration downstream. Changing the frequency of floodplain inundation can encourage invasive species to supplant the native vegetation. Most riparian and coastal animal species are specifically adapted to the flow patterns and other characteristics of their native habitat. This makes them vulnerable to disruptions in the flow and water levels.

Expanding in-stream storage to minimize flooding can result in reduced downstream flows. This reduction can, in turn, cause severe channel aggradation as the floodway fills with sediment. The result can be a cascade of impacts as tributary channels begin to fill in with sediment. In fact, the natural channel can be buried, reducing habitat diversity and eventually result in increased flood elevations as sediment accumulates and the channel's capacity is diminished.

If human activity for development or flood protection constricts or expands the channel, nearshore area, or floodplain, the sediment transport dynamics are altered. This can cause sediment to accumulate in unanticipated places, or the bed or offshore zone can be scoured. In either case, the channel bed and banks can be destabilized rapidly both up- and downstream. For example, a new home may be constructed on a large meander with bank stabilization to protect it from erosion. In future years, increased lateral migration of the channel caused by that stabilization causes problems for existing structures downstream. The owners of those structures then take similar action to stabilize those streambanks, and so on. Such channel alterations march downstream, with individual homeowners exhibiting little understanding of—or having been given little guidance on—the overall impacts of their actions on channel dynamics or on the watershed. This results in the slow and almost imperceptible destabilization of a watershed, and loss of natural function or death by a thousand tiny impacts.

All of these activities in pursuit of development, urbanization, and flood protection have yielded specific, usually localized economic and social benefits, but the long-term impacts have placed both humans and nature at higher risk. Further, they have proved counterproductive, resulting in a system of "reactive" engineering through which the symptoms of the problem are treated at great expense while the underlying causes are not addressed and flood losses continue to rise.

After decades of using these approaches and failing to acknowledge the natural and beneficial functions and values of floodplains, we have destroyed a large proportion of our wetlands, deprived our river deltas of sediments needed to maintain marshes, prevented nutrient-rich flood water from reaching adjacent lands to replenish the soils, interrupted the protective functions of coastal barriers, and contributed to declines in water quality. We now realize that those wetlands, soils, marshes, unspoiled waterways, and related resources and their functions are crucial components of ecosystems vital to human life but which we had been taking for granted.

## Solutions and Recommendations

As pressures mount to utilize floodplains and coastal areas, it is imperative that we eliminate the attitude that it is acceptable to obtain short-term reductions in flood risk and/or short-term economic gains by shifting those costs to future generations or causing adverse environmental impacts. We need to replace this thought process with a new focus on ensuring the long-term environmental and economic sustainability of our floodplain ecosystems. In this context, we have presented below some suggestions for an overall policy change, more specific recommendations can be found in the full paper on the ASFPM website.

To begin, we need to modify the widespread view of floods as destructive forces of nature. Floods do not cause damage or suffering. Our decisions about where to live, work, and play are the cause. By anticipating the flooding process and planning our development accordingly, we can begin to effect change. Instead of controlling the water, we should control how and where we allow human activities to adversely affect it. The recommendations below reflect this paradigm for managing our nation's floodplains and flood risk.

In order to regain the sustainability of our water-based ecosystems and resources, we must adopt a new approach to floodplain management. The ASFPM sees this as a five-pronged strategy.

(1) Set a policy that the natural functions and resources of floodprone areas are worthy of protection and should not be sacrificed for human development.

(2) Prevent new development from encroaching on floodprone and environmentally sensitive areas.

(3) Remove existing development from floodprone and environmentally sensitive areas whenever possible.

(4) Rehabilitate and restore degraded riparian and coastal resources.

(5) Incorporate into all public and private activities at all levels a respect for and understanding of the functions and resources of floodprone areas along our coasts and waterways.

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# Part 2

# Communication—
# Human Behavior, Perception, Messages

# THE STATE OF KNOWLEDGE IN THE SOCIAL SCIENCES ABOUT HOW TO MOTIVATE THE PUBLIC TO PREPARE FOR FLOODS

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Where we are today, based on the conclusions from the cumulative social science research record, is that relatively strong, conclusive, and replicated science-based evidence exists regarding what it takes to teach the public what they need to know, and how to motivate the public to take actions to prepare for possible future hazardous events like floods. This record of scientific evidence provides a more effective basis for increasing public knowledge and motivating public preparedness than alternative popular approaches, for example, those based on good intentions, intuition, and limited personal experiences. A synthesis of what is known based on the social science research evidence accumulated to date is presented in this white paper. The key question is behavioral: "how do you help people in the public to stop, listen, and get ready for future disasters that most of them think won't really happen, and, if they do, will happen to other people and not them?" Most people think that way because they think that they are not at risk to high consequence low probability events. This perception of being safe is reinforced every day that a disaster does not occur.

**Preparedness behavior motivated most by disaster experience**. Perceptions of "being safe" change to perceptions of "being at risk" immediately after a disaster. In fact, experiencing a disaster has the strongest effect among all factors to motivate people to prepare for future disasters. Research on what has been popularized as "the window of opportunity" has found that the strong effect of experiencing an actual disaster on motivating survivor preparedness declines as time from the event passes because perceptions of safety re-emerge and rise to pre-disaster levels typically within an approximate two-year period after the event.

**Two key motivators in the absence of disaster**. In the absence of an actual disaster, the social science research record identifies two other factors as the strongest motivators ***by far*** of household preparedness action-taking. The first is "information received from official sources" about preparedness. To be effective, information must: come from multiple sources, be communicated over multiple channels of communication, focus on what actions to take, explain how those actions cut future losses, and be consistent (say the same thing) across the different messages received. The role of consistency across different messages in motivating public preparedness was not evidenced in a recently completed national study on pubic preparedness, but this is not reason to exclude it from the list of important factors to consider since its importance has been documented in multiple other studies. The second factor is "unofficial information observed, heard or received". The impact of "seeing" others prepare and mitigate is generally a stronger motivator for preparedness and mitigation action-taking than receiving information about the need to take actions.

**How people convert preparedness information received into preparedness actions**. A recently completed national "mega-study" of motivating public preparedness provided two major contributions to social science knowledge. First, the study was based on all the households in the country, and it confirmed the findings of studies previous studies that were performed on small populations in unique parts of the country. This lends great increased validity to existing conclusions. Second, it clearly identified the general social process that people go through to convert received preparedness information into actual household preparedness actions. This process can be described as follows. ***Information received*** and ***information seen*** are the two key factors that motivate the pubic to prepare. These two factors have "direct" effects on increasing household preparedness and mitigation. The more people hear, read, and see, the more they do to get ready. These factors also "indirectly" affect household preparedness. They do this by increasing people's ***knowledge*** and their perceived effectiveness or ***efficacy*** of recommended actions, and by increasing discussions (sometimes called ***milling***) with others about earthquake preparedness and mitigation. These factors, knowledge, perceived effectiveness, and milling, in turn, also increase household preparedness and mitigation.

## Conclusions On The Importance of Providing Information

These conclusions are very good news. In the absence of an actual disaster (which is the strongest way to get people's attention and motivate preparedness actions), the two major determinants of household preparedness are both "pliable." Policies and programs can be developed that increase information dissemination in ways that increase earthquake preparedness and mitigation. Moreover, the information to action-taking relationship is linear: the more information disseminated to households, the more they prepare and mitigate; the less information, the less preparedness and mitigation.

In comparison to information received and seen, most other factors do not matter much. Other factors either are not related to household preparedness and mitigation, or their effects either disappear or remain but are reduced to such small levels when the information factors just described are included and "controlled" in multivariate statistical models. These other factors include the increased probability of a future event (which is certainly useful to know about for other reasons) and demographic characteristics (which can constrain what people can afford, but have little effect on readiness motivation).

## For More Information about the Research

Citations to the published social science research literature on which the content of this paper is based are not here provided. However, another version of this paper with full referencing is available from the author.

# REASONING PATTERNS ABOUT FLOODING: SUMMARY OF RESEARCH CONDUCTED FOR THE INSTITUTE FOR BUSINESS & HOME SAFETY AND AMERICAN RIVERS

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In spring 2009, the Institute for Business and Home Safety (IBHS) partnered with American Rivers on a focus group/cognitive analysis study involving homeowners and opinion leaders, in order to gain a better understanding of attitudes toward flood risk and flood insurance. The cities of Davenport, Iowa, and Rock Island, Illinois, were selected as the sites for this research because they are located directly across the Mississippi River from each other and are subject to similar flood conditions and risk, but have very different approaches to floodplain management. Davenport has elected to adapt to the predictable annual flooding that occurs through local land use policies and building codes, while Rock Island chose to erect a levee designed to keep flood waters completely out of the city.[1]

Key findings related to understanding flood risk perceptions and attitudes about potential and real property losses follow:

- The relationship people have with a body of water, and the threat they see, is largely determined by the perceived degree of predictability. Based on predictability, people make a sharp distinction between river flooding, which they view as predictable, and other types of flooding (such as flash flooding). They also view river flooding s different from other (unpredictable) natural disasters such as hurricanes, tornadoes, earthquakes, and wildfires, more akin to a blizzard.

- People in the Quad Cities have positive emotions toward their rivers and their role in their lives and communities. Were it not for the Mississippi River, many believe they would have no town.

- Despite recent and historical floods, residents in the two cities do not see themselves at high risk for flood damage because they view the behavior of the Mississippi and other local rivers as predictable. They regularly interpret the phrases “100-year” and “500 year flood” as referring to an extraordinary event in the life of a river, not an annual exceedance probability. If these concepts were interpreted as an annual potentiality, it might change perceptions about the predictability of their rivers and, perhaps, their positive feelings toward them.

- People feel confident about their knowledge of how flooding works and their level of risk. Detailed flood maps reinforce this by showing which areas are in a floodplain and which are not. The unintended consequence is that people believe that if their home is not in an area designated as a high risk flood zone by the federal government, they do not need to buy insurance.

- Fear is not a very effective way to increase flood insurance take-up rates or structural mitigation. One reason is that people do not see river flooding as endangering their lives. Instead, they view flooding as something that can be prepared for and survived fairly easily.

- People in both communities defend their flood management systems. Levees are seen as having served as solid protectors to residents of Rock Island, whereas those in Davenport "hate concrete." In all groups, there was an underlying comfort with the status quo and the decisions made by their own communities regarding flood protection.

- The possibility of levee failure was not volunteered by any of the Rock Island focus group participants; even when pressed, most did not even entertain the possibility that this could occur. They believe that the levee will always be there to protect them, but they pay little attention to its actual maintenance and structural integrity.

- When it comes to structural mitigation, participants feel that they know what to do. For example, they understand the need for water to be able to flow through the ground floor of a structure, moving mechanical systems to higher floors. In this way, they believe that flooding is manageable.

- People have a natural compassion but are tired of paying for recovery for the same properties over and over. They believe that those who choose to live in flood-prone areas should be responsible for all of their own recovery costs, because they knowingly took a predictable risk.

- Most people believe, rather strongly, that no building should be allowed in areas that repeatedly flood. They also approve of government buy-outs in these areas.

**Endnotes**

1. According to National Flood Insurance Program (NFIP) statistics, from January 1, 1978, to April 30, 2009, Davenport homeowners filed 836 flood-related insurance claims for a total of $11 billion; during the same period, Rock Island homeowners filed 927 claims for a total of $6.6 billion. As of April 30, 2009, there were 853 flood insurance policies in force in Davenport and 442 in Rock Island.

# COMMUNICATING RISK—
# TEN KEY LEARNINGS FROM THE FLOODSMART CAMPAIGN

**Mary Jo Vrem**
***Federal Emergency Management Agency***

The mission of the National Flood Insurance Program (NFIP) marketing campaign over the past six years has been to grow the number of policies in force each year, and to protect individual home and business owners in both higher and lower risk areas. The FloodSmart campaign has been successful in achieving its objectives through an integrated mix of advertising, consumer direct mail, media relations, stakeholder relations and outreach to insurance agents.
The need for, and availability of, flood insurance is never communicated in a vacuum; rather, it is the payoff for how to solve the problem surrounding the risk of flooding that exists, or how to lessen the severe consequences that could come about from flooding. The likelihood of, and consequences from, flooding demonstrate the need; flood insurance the solution. So, what communications work best to influence the consumer's mindset about risk so they get to the "prize" of flood insurance? Set forth below are ten key learnings the FloodSmart campaign has gleaned over the past six years through its national, regional and community marketing and outreach communications efforts.

**1. Communicate Both Sides of the Equation**

The FloodSmart campaign has learned that it is important to communicate both sides of the risk equation of RISK = PROBABILITY x CONSEQUENCES . The various campaign elements of FloodSmart advertising, outreach and collateral motivate people to stop and think about the likelihood or probability of flooding, i.e. how it is very possible for them to flood; and communicate how devastating the consequences can be if/when they do flood. For homeowners who believe "It'll never happen to me," it was important to convey in a meaningful and compelling way that flooding could indeed happen to them—by explaining the various sources of flooding or by debunking some of the myths surrounding risk. And for those who think "How bad can it be if it does happen to me?" the campaign expressed how flooding could end up costing a lot more than one might think.

**2. Talk To Me**

Another key learning for the campaign has been that directly telling people they are at risk can sound "preachy" and they might reject it because it goes against what they believe. Too sweeping or general of statements aren't as effective as those that come across as truly speaking to each homeowner individually. For example, the campaign evolved one of its slogans from "Everyone is at risk" (concept that was found too general to be true and relevant by consumers in focus groups) to "Know your risk" which is more engaging and empowering.

**3. Arm and Empower**

Empowering consumers has been the campaign's way to get them involved and thinking about flood risk and flood insurance. Providing the tools and resources for people to learn

more and get educated about flooding and the flood insurance product has worked very well. For example, on the consumer website, FloodSmart.gov, there is a Flood Risk Assessment tool where the viewer can enter his or her address and receive information regarding their risk level, a range of premium costs, and nearby agents in their area for them to contact to buy a policy or get more information. The communications have made sure consumers have all the information they need to complete the purchase decision – determining their home's risk, estimating their own premium, finding local agent information, and being supported with tools and resources.

**4. It Doesn't Take A Katrina**

While Hurricane Katrina undoubtedly brought the issue of flooding front and center to the entire country, years later many Americans still believe that it takes a storm of that magnitude or a severely-flawed infrastructure to experience a flood.

"Wherever it can rain, it can flood." Something as simple and obvious as that statement has had a dramatic effect on changing the way people think about floods. It is crucial to communicate risk in a way that makes it seem real, tangible and relevant to each audience. The two ways the campaign did this was communicating the sources of flooding and tackling the misconceptions around the risk of flooding and flood insurance.

- Communicating the sources of flooding has been very successful: Articulating, describing and showing how flooding can happen anytime and from a variety of sources – heavy rainstorms, snow melt, tidal surge, etc. The consumer website utilizes tools such as the Flood Risk Scenarios which animates for the viewer how flooding may occur based on various situations.
- Identifying and addressing misconceptions around flood risk and flood insurance was an important focus for communications. Through conducting qualitative research, some of the most common and prevalent misconceptions were:
    - Surely my homeowners policy covers flooding
    - I won't flood because I don't live near the water
    - How much damage a couple of inches of floodwater can cost
    - I don't qualify/can't get flood insurance
    - I'll never flood based on past experience, or the lack thereof – never have/never will, flooded here once so it won't again, 100-yr flood myth, etc.
    - Flood Insurance is just too expensive
    - If I do flood, the government will bail me out

**5. How Bad Can It Be?**

We have also learned that Consequences messaging can be extremely successful at motivating action by getting homeowners to imagine, or better yet--think through, the devastating consequences of flooding. These consequences can be emotional, material or financial. This line of communications has been particularly effective for those "fence-sitters" who acknowledge some level of risk for their home, but don't have a full appreciation of just how damaging a flood can be. The campaign brought to life how a couple of inches of floodwater can cost tens of thousands of dollars in damage, or how one's entire savings could be wiped out from a heavy rainstorm. While this approach may not modify the behavior of

those who unequivocally believe they are not at risk for flooding, it does impact homeowners who realize that the benefit of having flood insurance outweighs the cost of the product -- the notion of "Do the math. It's worth it."

**6. Repeat, Repeat, and Repeat Again**

While this is a fairly detailed finding, it is still a vital one – when a specific misconception lingers over time, tackle it in as many communications as possible. For example, the FloodSmart campaign has consistently communicated, either as the main message or as a support point, that "Homeowners insurance does not cover floods" -- a fundamental fact that, research shows, is still widely unknown. Refining the language may be helpful at some point as well – this year, the line may read "Only flood insurance covers floods." Regardless of the exact wording, it is important to be aware of and preserve core messages throughout communications.

**7. Leverage the Relevance**

Timing is a great ally of the campaign and we have learned that messages can be amplified if delivered at the right time and around the appropriate circumstances. This is why we communicate risk by tapping into the relevant events or situations, such as:

- Map changes – mapping is happening; take advantage of PRP
- Moving to a new home – don't risk your largest investment
- Seasonality – hurricane season, winter flooding, spring flooding
- Post-flood communications – Quick Response Unit efforts

**8. Know Thy Audience**

One size does not fit all and the FloodSmart campaign has learned that segmenting the different audiences is crucial. Growth can only be achieved by understanding the different groups we are talking to, who they are, and what are the most relevant and motivating messages. Some examples include:

- Commercial business owners and renters – can your business reopen if it floods
- SFHA homeowners – you are at high risk and here's what that means
- NSFHA homeowners – you can protect your home and your savings with the affordable PRP if you live in a low-to-mod risk area
- Buffer zone homeowners – risk doesn't stop at a line

**9. Consumer-Speak**

The tonality of the campaign has also been crucial in delivering a credible message. FloodSmart has learned that it is key to achieve the right balance of speaking in a way that is authoritative and knowledgeable since the communications are coming from FEMA and the NFIP, but also compassionate and empathetic.

To this end, peer-to-peer communications offer credible, real support for the proposition that flooding can happen anywhere, anytime. A homeowner hearing or reading about a flood experience that happened to a fellow resident resonates in a way that nothing else can. There is a built-in sense of authenticity and relatability that cannot be matched by an organization or government entity talking "at" the homeowner.

Making the communications simple and concise is also critical – all the statistics and data and factoids won't necessarily sway everyone. Tapping into the emotional triggers and stories are oftentimes more impactful than a percentage chance, average premium cost or number of claims figures, no matter how dramatic they might be.

**10. Give Them Something To DO**

The ultimate goal of the campaign, to grow the number of flood insurance policies in force, has always been front and center in the campaign efforts. We learned from research that the key issue to tackle was not simply the lack of awareness about flood insurance, but the fact that people did not think they were at risk. This is why, from our very first execution, we have always provided clear calls-to-action, going beyond a mere awareness building campaign:

- Unique 1-800 #s – callers can get more information (brochure) or be transferred to an agent
- FloodSmart.gov and unique URLs
- Business Reply Cards on print executions
- Agent contact information

# CHANGING FLOOD RISK BEHAVIOR


## Patty Templeton-Jones
***Fidelity National P&C Insurance Group***


When Congress passed the National Flood Insurance Act it was based on the understanding that flood insurance can promote public interest by providing appropriate protection against flood losses and encouraging sound land use; and that the objectives of the program should be integrally related to a national program for floodplain management.

An important objective of the NFIP is to break the cycle of flood damage. Many buildings have been flooded, rebuilt and flooded again. The Community Rating System (CRS) was implemented in 1990 to help respond to this and engage communities in enforcing sound floodplain management.

The CRS goals are:

- Reducing flood losses
- Facilitate accurate insurance rating
- Promote the awareness of flood insurance.

The CRS has been the most successful tool to be utilized that recognizes and encourages communities to implement new and more effective floodplain management activities. CRS Activity 330, Outreach Projects is part of the 300 series of public information activities and has been a CRS credit since the program began in 1990. The 300 series is built upon research findings from the 1980s.

The research finding recommended a two-tier approach to educating and motivating people to be proactive in protecting themselves from flooding.

- The first tier is a widespread general outreach to everyone in the community that introduces topics like flood insurance and retrofitting. This outreach would inform people where they could go for information.
- The second tier of an effective program is to provide more detailed information for those that want more information.

Activity 330 provides credit for community projects that take a proactive approach—credit for projects that reach out to people and give them information even when they do not ask for it. Its objective is to make people aware of the flood hazard, flood insurance, ways to prevent or reduce flood damage, and the natural and beneficial floodplain functions. Outreach projects are designed to encourage people to seek out more information and take the appropriate steps to protect themselves and their properties.

Since the Midwestern flooding of 1993, which led to the Flood Insurance Reform of 1994 which revamped the enforcement of the insurance purchase requirement, communities have become more active and sophisticated in informing their residents about the flooding hazard and what

can be done about it. In addition FEMA, Floodsmart, the National Weather Service and the Write Your Own Companies have launched numerous campaigns aimed at educating the public of the risk of flooding.

As a result of these activities, the number of flood insurance policies have increased from approximately 2.5 million to 5.5 million.

But we still have not accomplished our goals. The general public still believes:

1. I don't live in a flood zone (wrong—everyone lives in a flood zone)
2. I flooded once so it will never happen to me (wrong—only Mother Nature knows)
3. I don't live on the coast so I'm not in danger (wrong—most flooding events are rising water not storm surge)

The fact of the matter is if you live where it rains (which we all do); the chance of experiencing a flood is greater than experiencing a fire loss.

In order to change the behavior, one viable option would be a consideration of limiting the federal dollars spent on grants and low interest loans for people that choose not to protect themselves or build unwisely that puts them at greater risk. We must start our education at the grade school level if we want to change behavior in the future. The message needs to be repeated and presented through as many different sources as possible.

A multi prong approach is necessary. A program run solely by the local government or the federal government will not be as effective as one that works cooperatively with different agencies and organizations such as schools, insurance agents, building contractors, lenders, realtors, local and federal agencies—one that not only educates but changes behavior.

# USING STUDIES IN RISK PERCEPTION TO BETTER COMMUNICATE FLOOD RISK

**Heidi M. Carlin**
***URS Corporation***

**Jen Marcy**
***PBS&J***

**ASFPM Training and Outreach Committee**

David P. Ropeik, co-author of *Risk: A Practical Guide for Deciding What's Really Safe and What's Really Dangerous in the World Around You*, and author of the forthcoming *The Risk Response: Why We're Too Afraid of Some Things and Not Afraid Enough of Others*, defines Risk Communication as, "… a combination of actions, words, and other messages which convey information *in a way that acknowledges the concerns and values of the information recipients*, in order to help people make more informed decisions about threats to their health and safety," (emphasis added).

In order to property communicate flood risk, we need to first understand the audience. One of the main concepts of the National Flood Insurance Program is the 1-percent-annual-chance or 100-year flood, but Ropeik illustrates that percentages may not be an effective way to communicate risk:

> *Framing:* The way a choice is presented can distort the judgment that results. Imagine you are the mayor of a city of one million people and a fatal disease is spreading through your community. It is occurring mostly, but not exclusively, in one neighborhood of 5000 residents. With a fixed amount of money, you can either *(a)* save 1000 of the 5000 residents in that neighborhood, 20% or *(b)* save 2000 people out of the entire city of 1 million, 0.2%. What do you do? A sizable number of people in risk communication classes choose option A, which produces greater percentage effectiveness, but condemns 1000 people to death. Reframed, the choice would be: You can spend a fixed amount of money and save 1000 people or 2000. Presented that way, the choice is obvious. But the framing of the question in terms of percentages skews the judgment.

Using percentages may not be a useful way to portray flood risk; we may have to think of other ways to frame the 100-year concept. There are other ways general human behavior can help us understand ways to communicate risk in better ways:

**We are less likely to be afraid of something if we feel that we have some control.** Ropeik notes that this control can either be actual control (as in driving a car), or, "a *sense* of control of a process, as when an individual feels that he or she is able to participate in policy-making about a risk through stakeholder involvement through hearings, voting, etc."

**We fear something more if it involves a risk to our children.** Ropeik notes that the Environmental Protection Agency requires that all schools be tested for asbestos, but that requirement does not apply to other types of buildings usually occupied by adults.

**We are less afraid of old risks than of new ones.** When H1N1 first hit the country, there was a lot of fear. In summer 2009, many Catholic churches stopped giving wine with the host and they asked people to refrain from handshaking during the peace offerings. By the end of January 2010, the restrictions were lifted, even though the flu is still a risk. **Similarly, we are more afraid of risks of which we are more aware.**

**We are less afraid of natural risks than of manmade ones**. We fear radiation from nuclear waste or cell phones but we go outside without sunscreen all the time.

**We are more afraid of risks that we think can actually happen to us.** Before 911, terrorist attacks only happened to overseas embassies, now we know they can happen on American soil and we are both more fearful of them, and more aware of the behaviors of the people around us.

**We are more fearful of catastrophic events than of higher-probability, lower consequence events**, even though they also can cause us harm.

**We fear something more if there is more uncertainty about that risk.** For instance, risks associated with technological advances can create more fear because we may know or understand little about them.

**When we trust the messenger, the communication process, and the agency/company/institution that is supposed to help protect us, we have less fear about that risk.** Ropeik notes that, "trust is the central reason why two-way risk communication, in language that validates the feelings and values and heuristic instincts of the audience, is likely to be more effective than one-way communication that only offers the facts."

Given these tenets, what can we change about our flood risk communications to utilize this information?

**Give them control.** It is important to empower people to do something about their risk. We need to continue to tell people what they can do about it. Empower communities to involve their citizens in the decision-making process (mitigation plans, evacuation plans, emergency plans); tell people what they can do to reduce their risk (elevate, flood proof, insure).

**Involve younger generations.** Should we focus on the younger generations and hope they teach the adults? TADD (Turn Around, Don't Drown) is doing that, and it seems to be working – the kids get it – so hopefully they won't drive through flooded roadways when they get their driver's license.

**Keep it new; keep people aware**. Many communities still generally have outreach associated with a new flood map, and not a whole lot in-between. We should continue to remind people that flooding is a risk: teach the kids about flood risk, put it on the driver's test, make it a household word, and tell everyone, not just residents that live in the high hazard flood areas, etc.

**Make it human-made**. We often say that flooding is natural. What we might emphasize is that pavement, sidewalks, and other development in the floodplain have changed the way water moves through our environment.

**Let them know it can happen to them.** Personification of the risk is critical. People may not personalize numbers or percentages, but if they see a flood victim family and see what they had to go through, the message will hit home. Risk communication needs to be personalized. Geographically targeted communications could be the key to more genuine flood risk communication.

**Low consequence events can harm you, too**. We might tell people that it is more likely that you'll get water in your basement than up to your rooftop, but getting water in your basement isn't exactly fun or cheap. Here are some things you can do to reduce your risk.

**Create uncertainty.** There is a line on a map that may perpetuate the "in or out" perception. It also may create unintended certainty for the people just outside that line. We might change our communication to say that this line on the map is the best guess at what might happen in a specific statistical flooding event; the risk is not equal within or along this line.

**Build trust – or utilize people and organizations that already have the people's trust.** Currently, we stamp a government seal on every flood map. Instead, we might stamp a local, state, university, etc. seal on the map. We could also bring local experts to open houses and homeowner's association members, and locals who flooded, etc.

By giving people control over their risk, involving children in our messaging, keeping people aware of flood risk and making it new, making it manmade, letting people know it can happen to them, citing high-probability, low consequence events, creating uncertainty, and building trust, we may be able to change flood risk perception and flood risk behaviors.

# ALIGNING STAKEHOLDERS FOR RISK REDUCTION

**Vince DiCamillo**
***Greenhorne & O'Mara***

Despite the wealth of technical information, knowledge, and actual flooding experience the public, communities, and businesses do not take actions to significantly reduce flood risk. In this brief paper I will describe my observations and views on some of the causes of this inaction and an approach to align stakeholders to set the stage for actual flood risk reduction.

The public (property owners and non-property owners) do not take actions to reduce their risk of the impacts of flooding for two basic reasons:

- They don't believe they are at risk. It has never happened to them before, and/or the science is complicated so the probability of a flood seems so low that they are willing to take a gamble.
- They don't think there is anything they can do about it. While the public may recognize that they have a real risk they don't know what actions they can take to reduce their risk, or they can't afford to implement risk reduction measures.

In either case there is likely a lack of recognition of what a flood means to them in terms of financial loss, loss of irreplaceable personal effects, and physical and mental stress.

Communities (including public officials and policy makers) and businesses often take no actions for the same two reasons described above. Additionally, communities may not recognize all of the impacts caused by flood, including the effects on their tax base and future growth. Likewise, businesses may not recognize that beyond direct damage to their facilities and products, floods impact their work force and customers, both of which have a dramatic financial impact on their businesses.

The foundation of flood risk reduction is credible risk assessment data. This is key to all stakeholders recognizing that flood risk reduction is needed. There has to be a belief that the risk of flooding is real. Secondly, there has to be recognition that there are affordable actions that can be taken to reduce or mitigate the risks. Risk communication to stakeholders must be tailored to the various stakeholder groups, and speak to the impacts that flooding will have from an economic and personal standpoint. Messages to stakeholders need to include testimonials from success stories as well as testimonials from those who did not take action and suffered greater consequences.

To achieve true risk reduction their needs to be an alignment of actions between the public, communities, and businesses. This alignment will allow for consistent, synergistic actions and a maximum risk reduction impact.

The first step is for all parties to realize that that flood impacts on the public, the community, and businesses are interrelated. If homes are flooded but a business is not, the business is still affected if their workers are displaced on taken from work to address their personal losses. Likewise, if a business is directly impacted by a flood, workers may not be able to work and maintain their livelihood, even though their own home was safe from flooding. When businesses and/or homes are affected by floods the community could lose tax revenues reducing the community's ability to provide vital services to all of its citizens.

Once the mutual benefits of flood risk reduction are recognized by all parties, then the parties can start a dialog to identify measures and funding mechanisms that can help all parties reduce their risk of flooding. A few thoughts and ideas are discussed below:

- Businesses that recognize the impact of employees who cannot work due to flooding can justify developing programs to provide guidance and potential financial incentives to mitigate their homes against flood damage. Businesses can also work with community officials to help their workers obtain grants to support mitigation.
- Communities that recognize potential losses to their tax base can work with businesses whose facilities are subject flooding to help identify and support mitigation. For example, there can be potential tax incentives for businesses that mitigate.
- Businesses and communities can work together to develop and support educational programs for public schools and other public awareness programs that increase awareness to flood risk and measures to reduce risks.
- A well informed public can mobilize their elected officials to implement regulations that would encourage wise development away from flood hazards.

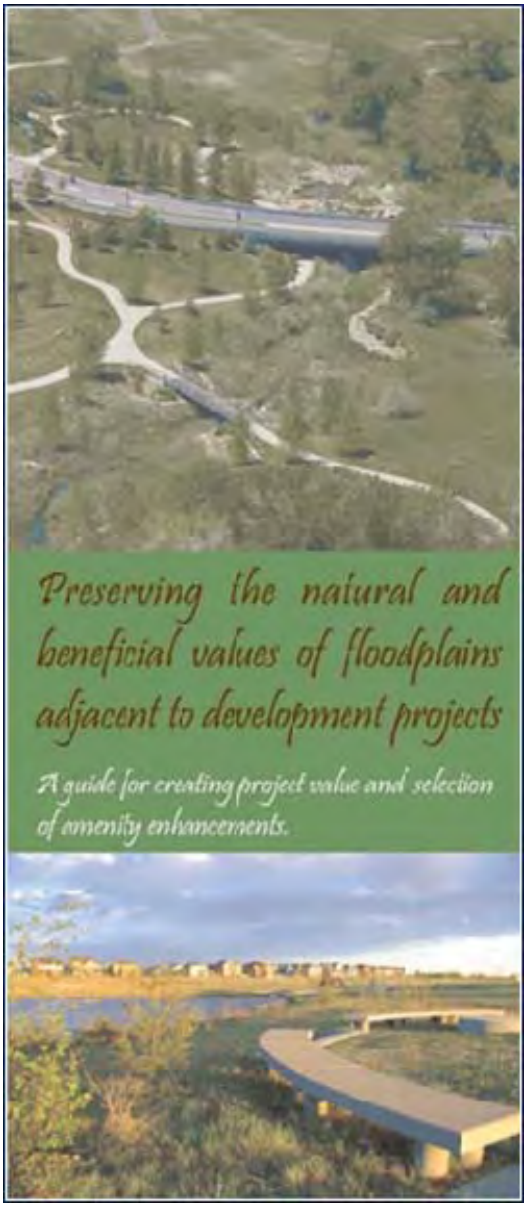
Up to now I have not mentioned the State or Federal role. Obviously the National Flood Insurance Program provides insurance that can mitigate financial losses due to floods. State and Federal government agencies also provide flood risk and risk assessment data, tools and information to support risk communications, and funding opportunities through grants or other incentives.

Coupled with State and Federal support, the public, communities, and businesses can maximize their opportunities to reduce their flood risk.

# PREVENTION AND THE PROFIT MOTIVE


## Bill DeGroot
***Urban Drainage and Flood Control District***


**Give prevention of new development in floodplains a high priority and a visible profile in all flood risk management efforts.**
Thirty-six years ago the Urban Drainage and Flood Control District (District) established a two-pronged work program: Fix existing problems created by poor development practices, while preventing those mistakes from being repeated in the future (my job). Since then our population has tripled (along with the structures that come with the people), while we have reduced the number of structures in the mapped 100-year floodplains by over 5000 units.




Preventive actions provide an enhanced community resource while avoiding flood damage and flood victims. Today the largest Federal prevention initiative is FEMA's minimum floodplain management regulations. We need to do more.

**Recognize the profit motive in why people develop floodplains, and provide a comparable profit motive for not developing the floodplains.**
We have to recognize the role of the profit motive in the development of floodplains, and provide comparable monetary incentives to preserve them instead. The profit motive includes a return on investment for the developer, *and* tax revenues and job creation for the local government; the same local government we now expect to regulate the floodplain. I've been working with local government elected officials, floodplain managers, engineers and planners; and private developers; for 36 years. I know the conflicting interests they deal with every day. Based on this experience, I am convinced that we will never be as successful at flood risk management as we want to be as a nation until we harness the profit motive for developing in our floodplains.

At the District we have been working to create a comparable profit motive for staying out of the floodplain, and capitalizing on its natural and beneficial functions (NBF) to increase the value of developing adjacent to the floodplain, for both the developer and the community. I'm not going to go through examples of that here, but we have

developed a brochure and mini-CD full of examples of this approach that can be accessed at http://www.udfcd.org/downloads/pdf/other/good_examples_brochure.pdf.

We have also been working with Ed Thomas, Esq., one of the nation's leading experts on, and proponents of, ASFPM's No Adverse Impact (NAI) initiative, in order to combine NAI, NBF and the profit motive to create an even more powerful tool for flood risk managers. In simple terms we will be saying, "You can't do *that* because you will be hurting your neighbor, but you can do *this* and still make a profit and enhance the community."

The District and the Colorado Association of Stormwater and Floodplain Managers (CASFM) will be meeting with representatives of the University of Colorado Natural Hazards Center and other researchers at the CU Boulder Institute of Behavioral Science on the possibility of funding additional research into the value and viability of the profit motive approach to flood risk management. We would welcome others to join us in this effort.

**Finally, a friendly suggestion: Any discussion of a flood risk management proposal should distinguish between that proposal's potential impact on remedial and preventive actions.** Too many times an idea is advanced without regard to how differently it can affect a remedial approach as opposed to a preventive one. For example, a discussion of the need to preserve natural and beneficial functions scares many local government people tasked with remedying existing problems in their community, because they "hear" a prohibition on structural remedial projects.

# A BIG BARRIER TO COMMUNICATING FLOOD RISK: FEMA'S FLOOD MAPS! A Thought Paper

**Grant M. Smith**
***Dewberry***

I don't pretend to be an expert in flood insurance or in communicating flood risk. But I'm a good listener, and the thoughts in this paper represent the compilation of experience and listening over the last seven years in the private sector producing flood studies and flood maps for FEMA's flood insurance program. And this experience is tempered by thirty years in the U.S. Army Corps of Engineers, observing national government at work.

So why in the world would FEMA's flood maps be a barrier to communicating flood risk to the American people? The answer lies in the unintended misleading message to citizens when they get exposed to the program while purchasing a home. The basic question asked by the homeowner, or the real estate agent, is – "Am I in or out?" This, of course, refers to the Special Flood Hazard Area (SFHA) on FEMA's map. If you are "in," your residence is inside the SFHA and you can't get a mortgage without buying the insurance as mandated through the National Flood Insurance Program. If you are "out," you can sigh in relief because the mandatory purchase requirements don't apply.

The message commonly received, unfortunately, is not the message intended by the government or by FEMA. The message implies that the line is an absolute: that if a home is "out" even a smidgen, it's safe from flooding. And since the government doesn't require you to buy flood insurance, you probably don't need it. Not so. The SFHA line depicts the 1% annual chance flood – something hard to understand as a layman and commonly reported as the one chance in a hundred years flood (wrong again). In reality, a homeowner with a home *on* that line actually has a 26% chance of experiencing a flood in the 30-year period covered by the normal mortgage. A homeowner further inside the SFHA can have a much higher probability of flooding.

What isn't communicated with the flood map is that a home just outside the SFHA has a 25% chance of flooding during the normal mortgage lifetime, almost as high a risk as for a homeowner just inside the line. This is one reason why flood maps can be real barriers to the effective communication of flood risk.

Here's another reason. For accredited levees, the flood maps show the SFHA inside the levee. The message again is that if you live outside the levee, you're safe. Flood managers know that levees can't assure protection, that all those living near a levee should understand the risk. But the maps don't communicate that risk, and in fact send the wrong message, giving the false sense of security that the levee will absolutely contain the flooding.

What to do? After years of citizen, media, and other misinterpretation of the message sent by the FEMA flood map about risk outside the SFHA, the best solution that has seen some traction

(maybe slipping recently) is to increase some form of mandatory purchase beyond the 1% annual chance flood to include homes inside the .2% annual chance flood, and the area behind levees and downstream of dams. This solution would help correct – and protect homeowners from – a lot of misinterpretation, by forcing acknowledgement of flood risk through the flood insurance program and mandatory purchase.

But could this solution really work? The answer may have nothing to do with real flood risk or the duty to inform citizens about it. The reality is often political, driven by economics and the fact that many people who live in high-risk areas are poor. So how can a Congress focused on constituent support impose the economic hardship of mandatory flood insurance purchase on voters?

I offer one possible idea for consideration: a time-scaled income tax offset based on taxpayer situation. Time-scaled to allow a choice of time that would provide political cover beyond immediate reelection cycles, and tax offset to allow a tax credit for lower income homeowners to ease their burden. Somehow we've got to get these homeowners insured, for their own good and for the common good.

Whether my idea of a minimum mandatory level of insurance is a good answer or not, FEMA must find a way to improve the unintended message that flood rate maps send about flood risk. These maps should not be barriers to communicating flood risk to the public. The rate maps themselves, or maybe accompanying specialized risk maps should clearly communicate risk (by percent chance of flooding or color coded risk zones) to homeowners outside the current SFHA, living behind levees, and living behind dams, This could ensure that all citizens and communities at least know about the true risk of flooding and can then act on that knowledge.

# EXTREMES REVISITED—
# AN ESSAY ON COMMUNICATING FLOOD RISK

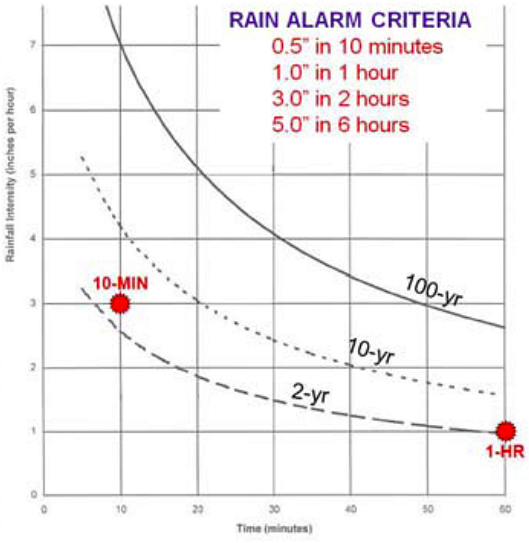
**Kevin G. Stewart**
***National Hydrologic Warning Council***

Have you ever heard someone say – *"What if the worst happens and we have a 100-year flood?"* I wonder how many people think this way. I suspect that that number is quite large but I know of no research that supports this opinion. A more disturbing question might be . . . how many professional engineers, floodplain managers and stormwater authorities would agree that the 100-year flood is the worst thing they can imagine? I hope that number is very small, but I have my concerns that the truth might be disappointing.

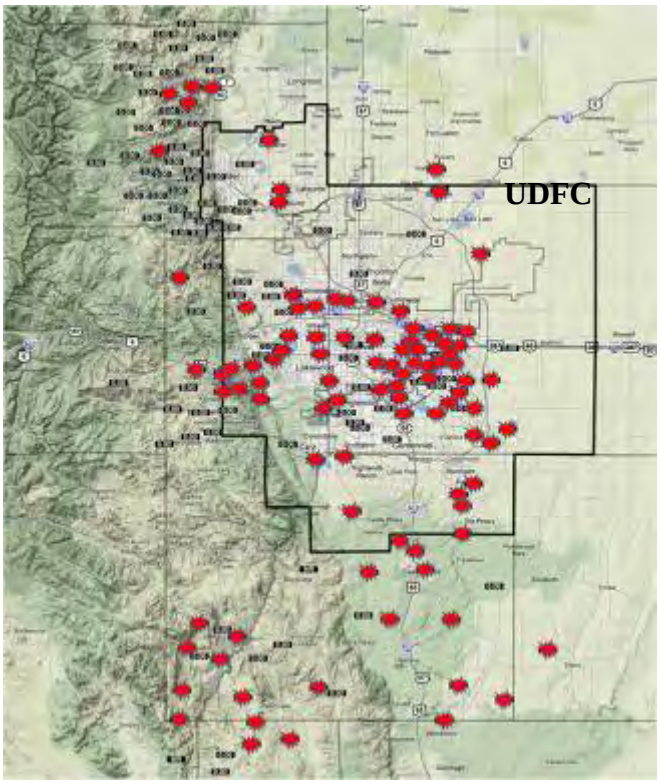
FEMA, ASFPM, NAFSMA, ASCE, USACE, and other federal agencies and organizations, have recently been seeking answers to questions like this. Katrina's impact has been a major motivating factor, but since that 2005 hurricane a number of other flood events have caused further concern. The National Flood Insurance Program (NFIP) fund is in the red and FEMA wants a better way to address the problem than just continuing along the same unsustainable path.

In the 2007 edition of *Flood Hazard News*—the annual newsletter of the Urban Drainage and Flood Control District in Denver, Colorado—an article entitled "Understanding Extremes" pointed out that alleged rare events actually happen quite often, and data from the District's automated flood detection network known as the ALERT System was used to illustrate this truth. Given the two unusual flood seasons that followed, it seemed like this might be a good time to refresh the 2007 table/chart and keep the dialog going about what really constitutes an extreme event and how we—the so-called flood experts—should communicate our understanding about flood risks when talking with others.

| Year | Alarm Days | Gage Points |
|---|---|---|
| 2009 | 32 | 151 |
| 2008 | 6 | 42 |
| 2007 | 17 | 53 |
| 2006 | 13 | 45 |
| 2005 | 10 | 38 |
| 2004 | 18 | 61 |
| 2003 | 13 | 70 |
| 2002 | 8 | 17 |
| 2001 | 14 | 57 |
| 2000 | 7 | 34 |
| 1999 | 20 | 62 |




The table shows how 2009 crushed earlier alarm records that date back to 1986. Only the last decade of statistics are provided because, over the years, the ALERT rain gage network coverage has increased substantially thus skewing the comparison. For example, the network installed in southwestern Douglas County and southern Jefferson County after the 2002 Hayman wildfire did not come on line until 2003. Regardless, it is fair to conclude that while 2009 is not considered a big flood year; it definitely produced a high number of heavy rain events with intensities exceeding the 2-year frequency.




The District serves the greater Denver metropolitan area of 2.8 million people and covers an area of 1,608 square miles. The map shows the extent of the District's automated flood detection network. The red stars on the map designate locations where heavy rainfall was measured by the ALERT System in 2009. The system logged a record number of 151 alarms on 32 days with each of those alarms reflecting a rainfall intensity that equaled or exceeded the 2-year point rainfall frequency according to the NOAA Atlas. The most intense 5-minute rainfall recorded during 2009 was an 11 inch/hour rate that occurred on July 20. While that rainfall rate exceeded the 100-year threshold (see figure on previous page) and might be considered a rare event by some, an inspection of 20+ years of record will show that more intense downpours have occurred on a number of occasions. An evaluation of "rare floods" on a national scale would very likely reveal a similar finding—that extreme events actually occur quite often and depending on where they occur, they may or may not get much attention.

As floodplain managers and designers of major drainage and flood control facilities we tend to stay focused on engineering design thresholds and in doing so, we talk a lot about that single event. We attempt to communicate flood risk in terms of frequency or probability, e.g. 100-year or 1% annual chance. Sometimes we try to describe the 100-year flood's likelihood over a longer period of time like 30 years—the term of a typical home mortgage—as having a one-in-four chance of occurring. While we may well understand what we are saying, our non-technical audience may not fully appreciate how this affects them personally.

Consider this . . . Knowledge of local flood history can be extremely helpful when trying to make a connection with people and gain their trust. People like to hear and tell stories about past floods. Let others tell their stories whenever the opportunity presents itself. After a short journey through the past, it may be much easier to discuss flood risk in ways people can better comprehend.

Sometimes flood history is lacking for a specific location. In this situation remember that extreme floods have certainly occurred somewhere nearby. One good example is the Morrison flood of 1938.


Bear Creek flood levels in Morrison between Market Street and Mount Vernon Street downstream of the Mount Vernon Creek confluence. The "Historical Flood High Water Mark" depicts the level of the September 2, 1938 flood.

That particular flood exceeded the 100-year design flood on Bear Creek through downtown Morrison, but the most noteworthy fact that sticks in my mind is that Bear Creek was not the main source of flooding; rather it was the Mount Vernon Creek tributary that peaked at twice its 100-year discharge. The cause of the 1938 flood is another useful fact to point out—it resulted from a very intense rainstorm that dropped nearly 8-inches of rain at its core, while the design rainfall used for calculating the 100-year flood is less than 3-inches. As engineers we should own up to the fact that even our best flood control projects and land use management practices will fail to protect when too much rain falls.

Catastrophic flooding from events like Hurricane Katrina and worse will occur in the future, but not in the District—right? That's what we would like to believe but most of us know better. As engineers, acclaimed as "experts" on floods, we should continue to educate ourselves about extreme events and find better ways to more effectively inform others about the true risk of flooding and what individuals and families can do to protect themselves.

# A NEW LOOK AT THE VERY OLD SUBJECT OF FLOODING

**Terri L Turner**
***Georgia Association of Floodplain Management***

At least twice recently, ASFPM professionals have expressed concern about the public's misunderstanding of flood hazards, flood events, mapped floodplains, and most importantly, flood terminology. (See, for example, "A Plea to Floodplain Managers," by Janet Thigpen, which appeared in the Newsletter of the New York State Floodplain and Stormwater Managers Association, Summer 2009; and also a draft white paper, "A Proposed Method for Categorizing Extreme Rainfall Events in Temperate Climates," by Thomas M. Grisa, Director of Public Works for the City of Brookfield, Wisconsin.) As a followup to those two concerns, I offer the following suggestions.

My first thought is that we need to rate storms based on the 2-5-10-25-50-100-500-year event from the engineering school of thought—otherwise, more than a hundred years of engineering and engineering related text would have to be scrapped. That may well be infeasible since all past and recent civil engineering designs are based on it.

The frequency-based scale probably can't be abandoned. Grisa's premise of using probability-based values (i.e., the reciprocal of the frequency value) instead has much merit. These values are much less confusing and misleading to the public (and to scientists and engineers). Almost everyone can accept that storms with just a 2% probability of occurring may occur in two consecutive years, but it's counter-intuitive to have two "50 year storms" in two years.

I propose that we call them R-factors for "Risk" instead of (Grisa's) G-factors, as below.

| Category of Storm | Probability (in 1 Year) | Rainfall Intensity (in 1 hour)* | Total Rainfall (in 24 hours) | Risk of Flooding |
|---|---|---|---|---|
| R-1 | 50% (2-yr storm) | 1.5 in/hr | 3.75 inches | Very Low |
| R-2 | 20% (5-yr storm) | 2.0 in/hr | 4.9 inches | Low |
| R-3 | 10% (10-yr storm) | 2.5 in/hr | 5.75 inches | Moderate |
| R-4 | 4% (25-yr storm) | 2.9 in/hr | 6.5 inches | High |
| R-5 | 2% (50-yr storm) | 3.3 in/hr | 7.4 inches | Very High |
| R-6 | 1% (100-yr storm) | 3.6 in/hr | 8.0 inches | Extremely High |
| R-7 | 0.2% (500-yr storm) | 3.9 in/hr | 8.5 inches | Almost certain |
| Note: Anything that meets or exceeds a 25 year storm should be considered a "high risk" | | | | |
| * Ref: http://www.hydrocad.net/pdf/TR-55%20Appendix%20B.pdf | | | | |

Since most jurisdictions storm systems are only designed for a 25 year event, then anything above that would be a "high risk" storm because storm systems are being stretched beyond their design capacity.

From an engineering perspective, the "risk of flooding" column still has some problematic variables such as elevation of site, antecedent rainfall and soil saturation, gradients and soil types, amount of impermeable surfaces nearby and ground texture/characteristics/cover (Manning's roughness, etc).

While we are focused on changes, I propose that we cease calling the maps that we use to regulate flooding, "flood maps" or the "NFIP maps" or the "floodplain maps" or any one of a hundred things that we have been calling them in the past. Instead, I propose that we start calling them

"flood risk maps" with

"flood risk zones, including"

- high risk zones (A and V)
- moderate risk zone (shaded X)
- low risk zone (X)

Ultimately, all of these areas are at risk of flooding given the right circumstances. This fits right in with FEMA's RiskMAP initiative.

Finally, I propose that we cease calling it the "base flood elevation" and begin calling it the "regulatory flood elevation" for the "regulatory floodplain" (instead of "100 year floodplain" or "the area of the 1% chance flood").

The old "500-year floodplain" or "the area of the 0.2% chance flood" can be called the "regulatory floodplain fringe" and should also include some regulatory standards of its own—standards that fall somewhere between those of the "regulatory floodplain" and (what I propose we call) the "non-regulated floodplain" (the "X" zone on the old maps and the new maps—described on the old maps as "areas determined to be outside the 500 year floodplain" and described on the new maps as "the area outside the 0.2% chance floodplain"). Based on what we have just seen in Atlanta, flood insurance should be required but, obviously, at lower dollar rates than in the "regulatory floodplain" and requirements from the "regulatory floodplain" such as elevation, should be highly explored.

The way we, as floodplain professionals, view and refer to flood hazards, flood events, mapped floodplains, and most importantly, flood terminology, as a whole, is somewhat antiquated and in many respects, it is "downright broke." We can either sit on our collective laurels and continue to use the system "as is" (and let the public continue to view us as "either lying or incompetent"), or we can put our vast knowledge and years of experience as floodplain managers together to come up with a workable solution.

**Acknowledgments**
Editorial assistance provided by Garrett Weiss, CFM, Georgia Association of Floodplain Management.

# TOWARDS APPROPRIATE COMMUNICATION OF FLOOD RISK

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***U.S. Army Corps of Engineers***

**Charles Yoe**
***College of Notre Dame***

## Introduction

The U.S. Army Corps of Engineers national flood program has evolved from flood control to flood protection to flood damage reduction and now to flood risk management. Flood risk is not a new reality so much as a new realization. Flood risk management is not about levels of protection. It is concerned with existing and residual risks and how ownership of the responsibility for managing those risks changes. Characterizing the flood risk in ways that are meaningful and useful for decision making purposes to the Corps various constituencies and stakeholders is going to be critical to the Corps success in flood risk management decision making.

## Communicating Technical Terms

"How do we explain the 100-year event to the general public?" a Corps analyst asked during a recent risk analysis workshop. The answer is, you don't. Most of the terminology used in communicating flood risk has its source in the science of hydrology. Short hand terms have been used to communicate risk such as the term "100-year flood." The scientist understands this is short hand for statistical value that can have a lot of nuances that acknowledge that there is uncertainty. As uncertainty has been incorporated into flood estimates this term has continued to be used as the most common description of risk. Even the profession has been reluctant to give up this terminology in communication with the public despite the fact it is almost invariably misinterpreted. The public frequently completely misunderstands what this term means and almost believes that floods have memory. "We just had the 100-year flood so I don't have to worry about a flood that large for the next 100 years." The general public does not care about the 100-year event. Exceedance frequencies and recurrence intervals are statistical concepts that are fine for water resource professionals but they are not generally understood by the lay public and are wholly inadequate for characterizing risks for stakeholders and the general public. For instance, the following is a quote from USA Today (July 8, 2008):

> When federal officials repeatedly refer to "100 year" floods and levees designed to protect against them, they mislead people into thinking that such storms are once-in-a-lifetime events. Whatever statistical validity these terms ever had, they no longer serve the public, and the government would do better to drop them.

It demands that we change what we communicate to the public about flood risk. We also need to acknowledge that the terms we use and how we use them should communicate the risk in a way that is accurately understood and suggest actions that are appropriate to manage the risk. This

communication of flood risks has to be tailored to the specific audience's needs throughout the project life cycle. This must balance two considerations of 1) the need for accuracy and consistency and 2) the ability to vary a message for the audience.

### Communicating the Ownership of the Risk

For most flood risk management actions, the motivation for risk communication changes over the life cycle of the action. During planning stages as the risk is assessed it may be necessary to increase concern for a real hazard to motivate stakeholders to take preventive action based on ownership of the risk management responsibilities, e.g., restricting development in the drainage basin, restrictive zoning in the floodplain, buying flood insurance, developing an effective evacuation plan. In recently flooded areas the communication strategy may be to manage the residents' outrage. In other instances simple public relations communications may suffice.

Building a project can alter the structure of the risk management responsibility. Federal reservoirs transfer much of that responsibility to the Corps while local projects such as levees create a partnership between the Corps and state or local government. None of these projects eliminate the risk, however. The state and local governments as well as individuals bear a share of the responsibility for the flood risk that remains after a project is built. These stakeholders need to understand that risk and the risk management options available to them for managing residual risks that are not tolerable.

The graph below shows that flooding is a virtual certainty for a person who spends a lifetime in a high risk floodplain zone. In the past, we have overemphasized the protection provided by a plan and underemphasized the risk that remains. Even with significant "levels of protection" the residual risk (darker color in the bars) remains significant. Stakeholders need to understand this and do their part to manage that risk to a tolerable level. For individuals in a "protected" area this could mean buying flood insurance and agreeing to evacuate the floodplain when an order is given. In extreme circumstances it can include measures like escape hatches in top floors and attics where flood victims are often found trapped.

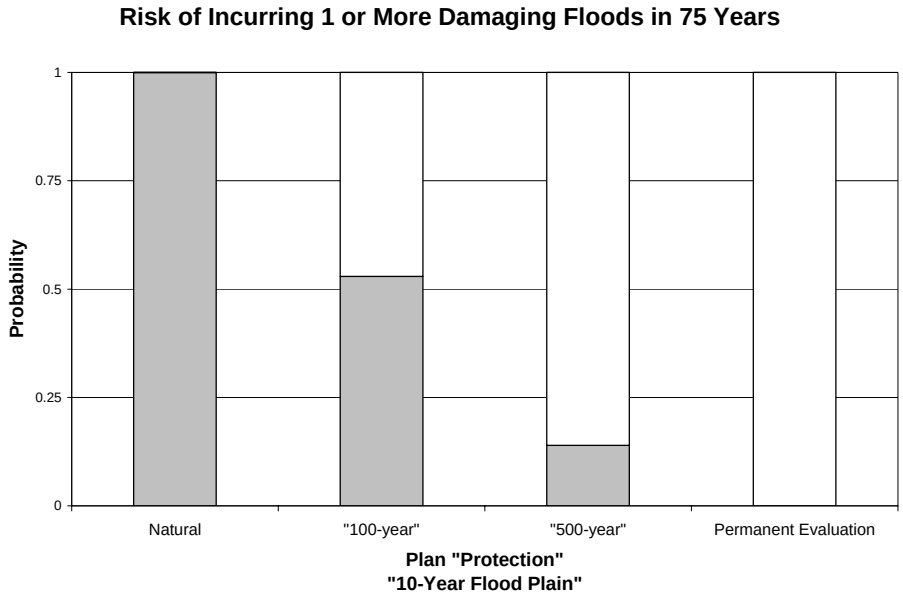


**Figure 1: Risk and Residual Risk**

During emergency situations, crisis communication must acknowledge the hazard, validate the public's concern, and give people effective ways to act in response to the crisis. In general, we need to tailor our communication so it takes into account the public's emotional response to an event. It should empower stakeholders and the public to make informed decisions while preventing negative behavior and/or encouraging constructive responses to crisis or danger.

It is often less important what we say than how we say it. Vincent Covello's research shows that during high stress/low trust situations the competence and expertise we as professional stress has relatively low importance (15-20%) to the public. Dedication/commitment and honesty/openness also account for 15-20% each. The most important aspect of high stress communication is caring and empathy at 50%. It is not enough to simply get the words right.


**Figure 2: High Stress Communication Attributes (Adapted from Covello, 2007)**

## Conclusion

As professionals in flood risk and flood risk management we should strive for terminology that is understandable and not open to misinterpretation. Misinterpretation leads to inappropriate responses to risk. This means we need to have new terms especially for communication with the public. Additionally, the terminology needs to be appropriate to the message and the audience. Finally, we need to resist the temptation of using terms that imply a "safe" or "not safe" message so that the public is encouraged to accept their role in risk management.

## References

Vincent T. Covello. 2007. Risk Communication. http://www.gchd.us/ReportsAndData/Presentations/PublicHealthWeek2007/Dr_Covello_Risk_Communication_Presentation.pdf

# CHANGING HUMAN BEHAVIOR THROUGH EFFECTIVE COMMUNICATION


## Cheryl Small
***National Flood Determination Association***


Last September the metro Atlanta area was hit with 18 inches of rain within a 24-hour period. In the storm's wake, entire neighborhoods were flooded by water levels between the 1% and the 0.2% annual chance flood exceedance levels[1] leaving many residents wondering why they were not aware of the potential for flooding in their neighborhood. Some property owners had built their homes in these areas without the consideration of the potential for flooding and without the financial protection of flood insurance. The devastating effects of the flooding, including the amount of uninsured flood losses, confirmed the results of a 2008 study by the *Ready Georgia* campaign that indicated Georgia residents were not personally prepared for a disaster[2]. Since this time, Governor Sonny Perdue and the Georgia Emergency Management Agency, the *Ready Georgia* sponsor, have redoubled efforts to help citizens to become more aware of the risks of flooding and to take steps to mitigate the impact of future flooding events. Unfortunately, what happened in Georgia last year is all too common.

Each year flooding throughout the Nation reminds us that despite the efforts of many over the past few decades, namely the National Flood Insurance Program (NFIP) and the Association of State Floodplain Managers (ASFPM), people continue to grossly underestimate and misunderstand the risk of flooding and its catastrophic impact. We also witness public officials, politicians, consumer groups and members of the media perpetuating the lack of understanding and exacerbating the underestimation of the public with regard to flooding through word and action. History will continue to repeat itself in the form of homes and businesses suffering from catastrophic, uninsured flood damage if people do not understand risks associated with flooding. If we can improve the method of communication and alter the message being conveyed with the objective to cause the consumer to visualize flooding, we can begin to change human behavior.

**Methods of Communicating about Flood Risk**

Most communication to consumers about the risk of flooding relies upon the technical vernacular (for example, "100 year flood") developed from FEMA flood studies and Flood Insurance Rate Maps (FIRMs). While this jargon, based upon scientific and engineering methods, is understood by scientists, engineers and technicians, communications to the public containing such terminology as "100 year flood", "BFE", or "1% annual chance floodplain" have proven ineffective. These technical terms are not synonymous with a common-based vocabulary about flood risk so the consumer quickly dismisses the message. The result is that the public does not develop an appreciation of the risk due to flood, the potential for flooding and the financial exposure they face from flooding. Due to the lenders' mandatory purchase of flood insurance requirements as well as how flood zones are displayed on the maps, an "in" versus "out" mentality with respect to flood risk permeates public attitude. The Special Flood Hazard Area appears as a two-dimensional plane on the FIRM, and either a property is located on or inside the plane and the corresponding property owner is subject to additional floodplain management

ordinances, higher flood insurance premiums, and the requirement to purchase flood insurance on any loan secured by the property; or, the property is located beyond the edge of the plane and the property owner is free from these additional obligations.

FIRMs do not help a property owner visualize flooding and hence they can't understand the potential consequences from flooding. Instead, the flood maps and the lender's flood determination made using these maps are viewed as bureaucratic obstacles or worse yet, as pernicious means to diminish the value of property. Empowering this misconception, public officials and consumer groups fight against FEMA's re-mapping efforts by citing the inequity in FEMA's maps without considering the question of risk to flooding. Proposed legislation both at the federal and state levels to forestall the use of revised flood maps, to exempt certain citizens from the federal mandatory purchase of flood insurance requirements, or to remove certain building requirements designed to mitigate against future flooding, illustrates that even our elected officials fail to understand the message being communicated by the FIRMs[3].

**Overhauling the Methods of Communicating about Flood Risk**

Communication about flood risk must extend beyond regulatory requirements for lenders and focus on helping the consumer to visualize the effects of flooding. To be successful and accomplish this objective, FEMA must overhaul the style and method of communicating flood risk as well as the content of the message delivered. In recent years, the NFIP has attempted to publicize to the American public the real danger of flooding with television and print advertisements demonstrating the devastating effects of floods. Following the public backlash after Hurricane Isabel, the NFIP developed Floodsmart.gov, a flood insurance website for consumers, with the intent to "educate and inform partners, stakeholders, property owners and renters about financially protecting their homes and business from flood damage."[4] While FloodSmart is a positive step, much more needs to be done.

FEMA should consider a radical departure from current media strategies directed to the American consumer. FEMA should explore developing a *"flood" vocabulary* and the creation of *a new consumer language* for the public. Also, validity can be given to the old adage that "a picture is worth a thousand words". Employing visualization techniques could be highly effective, such as using 3D graphics, oblique photographic imagery models and computer-aided dramatization to make the flooding become real to the consumer and to communicate the dramatic effects of potential flooding. The ability to create this data at the county, town or neighborhood level would be very persuasive and powerful. The homeowner would be able to visualize how their home could be impacted by the river coming out of its banks, or by the broken levee or the storm surge. Historic floods dramatized to show flood levels from prior events would be compelling. Once consumers and business owners begin to understand that a property is not either "in" or "out" of a flood hazard area, but instead is at risk depending upon the amount of flooding that can occur, perhaps they will then begin concerning themselves more with living in less risky areas, employing mitigation techniques or protecting their properties with flood insurance.

Changing human behavior with respect to flooding requires effective communication designed for consumers. FEMA should assemble a group of education and communication experts with specialties in adult education, consumer marketing and graphic visualization to explore a new and radical strategy to communicate flood risk to the American taxpayer. As the message is

changed from one of "in" versus "out" in terms of a floodplain to a message of varying degrees of risk and possible levels of floodwater based upon the event, we can begin to change the public perception about floods leading to a change in behavior. Through these efforts, consumers can be better prepared so that the next time 18 inches of rain falls, Georgia - along with the rest of the Nation - will indeed be *ready*.

**Endnotes**

1. U.S. Geological Survey, "Atlanta Flooding Sets New Records," Edward Martin, Brian McCallum, September 24, 2009.
2. Effingham Herald.net, "Ready Georgia Finds Georgians Aren't Ready," June 15, 2009.
3. Several proposed bills in recent years, including H.R. 777 (US House, 2009), H.R. 3415 (US House, 2009), and N.J. AB 4379 (New Jersey Assembly, 2008).
4. Federal Emergency Management Agency flyer, "FloodSmart Campaign."
5. Federal Emergency Management Agency flyer, "What is Risk MAP?"

# FLOOD RISK MANAGEMENT IS A SOCIETAL CHALLENGE

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*The views expressed are those of the author(s) and do not necessarily represent those of the National Weather Service.*

## Introduction

Floods demonstrate nature's ability to amass significant precipitation and excessive runoff. Since floods are unpreventable natural occurrences, a renewed focus for social responsibility, vigilance, and understanding is necessary. The communication of flood risk needs to be enhanced and better coordinated so that the decision-makers and the public take the proper precautions. Towards that end, there needs to be better understanding of the natural floodplain and the social responsibilities in cultivating this resource.

## Call for Effective Communication of Risk

When significant rains fall and the floodplain swells with excess runoff, flood mitigation actions are employed. Major flooding challenges those living on the floodplain and first responders trying to protect them. A concern of the NWS is that the public may not heed the flood warnings and thus fall victim to these floodwaters. The NWS is employing the use of social science to elicit a better understanding of the public response to weather warnings. With social science research, the NWS aims to enhance risk communications and decision support services so decision-makers take effective actions.

In Flood Risk Forum #2, Dr. Dennis Mileti recognized that the public has limited ability to perceive *"increased probabilities"* for events. As such, the issuance of products showing the probabilities of danger does not increase public readiness actions, does not convey the risk to the community, and does not result in appropriate public action. A well crafted message, that effectively communicates flood risk and elicits appropriate public action, should be repeated through multiple channels and repeated multiple times. The well crafted message should explain what preparedness measures include and how these measures reduce loss. The public also requires cues, such as seeing others taking action. Most importantly, as Mileti states, "Information is the key factor that motivates public preparedness." The NWS is working on enhancing the message and the information within the message.

## A Call for Vigilance and Responsibility

In addition to the natural occurrence of floods, America's aging infrastructure is compounding the flood risk. In their "Report Card for American Infrastructure", the American Society of Civil Engineers noted concern over our Nations' aging infrastructure. They noted the deferral of maintenance and the lack of re-investment in flood protection and mitigation. A structure, which is operating less than optimally or beyond its design, is a weakness in the local flood protection

system and can ultimately lead to the loss of life and property. The NWS remains vigilant to this concern and is working with federal, state, regional, and local agencies and with non-governmental organizations such as ASCE, ASFPM, and NHWC in an effort to effectively communicate the risks of flooding before, during, and after the flood. To effectively address the risks, there needs to be a re-emphasis of the four adjustment factors added by the 2nd Assembly of the Gilbert F. White National Flood Policy Forum in 2007 to the original eight factors, namely (1) Rivers and Oceans, (2) Personal Responsibility, (3) Geographic Interdependencies, and (4) Awareness and Education

**Call for Renewed Floodplain Management Approach**

A growing concern revolves around the unknown consequences posed by climate change. The Intergovernmental Panel on Climate Change states that "the most widespread serious potential impact of climate change on human settlements is believed to be flooding" and that "riverine and coastal settlements are believed to be particularly at risk". While NOAA is garnering resources to better understand the risks posed by climate change, there needs to be a strong focus on sound floodplain management.

A renewed approach requires better integration of flood protection, local storm water, land-use regulations, and public policies. Floodwaters from one community should pose no adverse impacts to the adjacent community. Local storm drains should evacuate flood waters in a systematic manner without increasing flooding to the downstream communities. Land-use regulations need to be enforced to minimize the hydrologic impacts across the entire watershed basin. Poor floodplain management practices should be addressed today, as climate science emerges. The renewed approach is a recommitment to the original eight human adjustment factors described by the late Gilbert White.

Instead of pointing blame for excessive rainfall on climate change, more immediate attention should focus on living with nature's extremes and promoting the wise use of our Nation's floodplains.

**Conclusion**

Whether through natural occurrences, aging infrastructure, or global climate change, excessive flood waters and flash-flooding can challenge the best flood protection plans and the regulatory controls. Regulation may help alleviate excess flooding in a normal season, but regulatory controls may not prevent losses in extreme flooding. Therefore, renewed commitments to managing floodplains and improving communication of flood risks are needed to influence social behaviors and thereby effectively save lives and property.

*BE RESPONSIVE, VIGILANT, and AWARE OF YOUR FLOOD RISKS*
*DON'T WAIT FOR THE NEXT STORM!*

# DO WE NEED A STANDARD FEDERAL MESSAGE ON FLOOD RISK MANAGEMENT?

**Judy M. Soutiere**
***U.S. Army Corps of Engineers***

There is no standard, consolidated federal message on Flood Risk Management. There is no single definition or goal for flood risk management. It is generally assumed it is to reduce risk in the floodplain.

The U.S. Army Corps of Engineers (Corps) looks at Flood Risk Management as both the reduction of frequency of flooding and the consequences of that frequency. Most of the programs in the Corps are geared to reducing the frequency of flooding and not the consequences. The unintended message is that if you get a Corps project, then you have more space to build which may increase the consequences if the project design frequency is exceeded.

In the past the Corps has not done a good job on explaining that a project is designed for a certain frequency, and that there are consequences if that frequency is exceeded by an event. By not explaining this, people have developed a false sense of safety and security.

FEMA looks at Flood Risk Management as the reduction of consequences by providing maps of the hazards, requiring flood insurance in the high hazard areas and requiring zoning ordnances to reflect the hazards. This works if the communities want to be part of the NFIP. However, it does not stop all the problems.

Both organizations are confined to a message that has been developed as the program was authorized by law. Many programs have conflicting goals which create conflicting messages or the appearance of conflicting messages.

A national message on Flood Risk Management would allow federal agencies to propose changes to programs to support the national message. It is easier to tie to a message that all agencies are using than to try a go it alone. The national massage could be woven into all the programs to supplement the individual program message. The message would get out more because more people and programs will be stating it. A consistent message would be given. Many agencies could share in the development and deployment of the message, saving on resources.

With a common message, it can be woven through all the various programs, it is repeated and with the repetition from many parties, it is started to be believed. Dr. Mileti gave a presentation at symposium two where he talked about the way to get to a change in behavior and that repetition, many sources, many experts, is part of what it takes to make people change their behavior.

It is important that a national, consistent message be developed and then utilized if we want to truly reduce flood risk in the future. It will take time to change behaviors. Right now there is an opportunity to start the dialogue to develop the messages. “Smokey the Bear” has been around for decades but the message is still fresh, and it did change people’s behavior over time. But it is still being repeated because people need to be reminded. We need one for flood risk management.

# RISKY BUSINESS


## Diane A. Brown
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What is the biggest national threat in the U.S.? One in which Americans can play a role in contributing to their own destiny? No, it's not the economy or affordable health care, or even terrorism. It's floods.

Of all the natural disasters that occur on the earth, flood waters cause 80% of all deaths and damage. Not because of global warming or climate change, but because more and more people are in harm's way. The continuing growth of flood catastrophes in this country is in no small part attributable to the complexities of population and infrastructure from our urbanizing society. However, while modern technology is helping predict these events, precious little is being done to communicate flood risk to individuals and communities, even in high hazard areas. Is ignorance bliss? In the case of a houseful of water taking you by surprise, I think not! Helping people better understand, and accept, their personal risk will increase their preparations and actions to prevent and minimize their risk.

Whose job is it to inform people who live in floodplains about the risks they face, and what they should do in the event of an impending problem? It does not fall in the lap of any one bureau or agency. I don't wish to debate the placement and level of governmental authority, or worse, suggest creating another Federal Bureau to handle it! But I do mean to emphasize the absolute need to increase public understanding and urge our citizens to embrace responsibility for their own safety—not only those who are clearly, or even vaguely, at risk. Citizen participation will be essential. When everyone "gets it," peer pressure will come into play. It worked with seat belts, didn't it?

There are both individual and community elements of the awareness, calculation, perception, assessment, and acceptance of risk. It is psychological and social, personal and universal. Unfortunately, we in the flood loss reduction industry not only have varying missions, we have confusing definitions! To quote Walt Kelly's comic strip character Pogo, "We have met the enemy and it is us." (Did you know that was introduced on an Earth Day poster in 1970?) It will be critical to use the same terms, even if we are not all on same page with regard to policy. The bottom line is that it takes education to change behavior. But there must be a multi pronged approach and a consistent message. An awareness program undertaken only by the media or in schools or by the private sector or via government at the local, state, or federal level is inherently insufficient. Numerous entities talking about the same thing but differently will be confusing, and as such, ineffective.

That does not mean we need consistent messaging modes or sources. When I go to my doctor's office, they ask if I learn best by seeing, hearing, or doing, to which I always reply, "yes" (meaning all of the above). Everyone learns differently and so we must plan methods that are comprehensive. This does speak to the point about starting young, as change is often effected when youths get a message in school and bring it home to their parents. Cases in point: preventing forest fires, not smoking or littering, wearing your seat belt, driving under the influence, and even "Turn Around, Don't Drown"!

Participants in the ASFPM Foundation Symposium 2, "Flood Risk Perception, Communication, and Behavior," brainstormed about how we various agencies and organizations can have an impact on communicating risk. We talked about using a slogan (a memorable phrase used as a repetitive expression of an idea or purpose) and/or logo (a graphic depiction commonly employed to aid and promote instant public recognition). In fact, we chuckled about creating twin flood frogs Freddy and Frederica, or getting a celebrity spokesperson.

Purely and simply, a comprehensive public education campaign must be developed to help increase awareness of flood risk for all people in our nation. Not just those by rivers or on the coast or in the floodplains – all people everywhere. In order to be successful, it must

- Impart a sense of urgency,
- Be easy to grasp,
- Make sense!
- Span all ages and walks of life,
- Use multiple modes for delivering the message,
- Create appropriate perceptions across multiple channels,
- Reach the target audience, be where they can readily find it,
- Promise only what we actually deliver.

Here are just some of the representative entities that could take up the flag of this "know your flood risk" campaign (please forgive the acronyms in the interest of space): FEMA, US Army Corps of Engineers, EPA, NOAA, CSC, NWS, USGS, NRCS, National Park Service, academia, states, locals, Council on Environmental Quality, NIBS, Coastal States Organization, National Committee on Levee Safety, NEMA, ASDSO, NAFSMA, Environmental Law Institute, NHWC, NACo, ASWM, League of Cities, APA, Interstate Council on Water Policy, AWRA, ASCE, RFF, International Code Council, NLIC, PERI, TNC, American Rivers, IBHS, NFDA, Sierra Club, IAEM, NAHB, National Association of Realtors, ACP, TCF, National Wildlife Federation, environmental foundations, to name only a few. If all these entities would take up the same slogan and logo and simply use it within their organizational conduits and outlets, the impact would be immense. One approach could even be to coordinate our message with others who have hazards risk concerns, such as fires, hurricanes, and tornadoes.

What we particularly need, besides multiple partners, is an integrated mix of advertising, consumer direct mail and email, website postings, media interaction, stakeholder relations, and outreach with related industries. To not do something soon is not only foolish, it would be tragic. Here's my best shot for now, until we can brainstorm together again at the Forum . . .

"Keep Your Head Above Water!"

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# GETTING THE MESSAGE OUT: IS THE PUBLIC LISTENING? THEN AGAIN, WHY WOULD THEY?

**Jeanne Christie**
***Association of State Wetland Managers***

Water resources and natural hazards management professionals have been raising concerns about the consequences of building and developing coastal and riverine areas for many years. But policies do not seem to change. Or if they do, the change is very slow. Why is there such a enormous disconnect between what scientists recommend and what policy-makers and landowners choose to do? Clearly the message delivered is not always the message received.

This was illustrated over the past year in news coverage about FEMA floodplain maps in the state of Maine. In January of 2009 a state legislator proposed funding a project to delineate floodplains, but necessarily to protect people from floods. Instead the purpose of the project was to protect people from FEMA--that is to more accurately map floodplains to contest FEMA maps and eliminate the need for homes and businesses to have flood insurance http://kennebecjournal.mainetoday.com/news/local/7403553.html . This perspective was echoed in another story in the fall of 2010 where the city of Portland Maine raised similar concerns about FEMA maps that identified the Portland harbor as a high hazard area http://www.eenews.net/public/climatewire/2009/09/29/1 . The city planned to dispute the maps. The process of challenging proposed floodplain maps and gathering more data should ultimately yield better information to define who is or is not at risk. But the challengers are motivated by economic development not public risk.

Changing public opinion is not easy, but it's necessary to change public policy. Everyone, including environmental groups, advertisers, political parties and even Hollywood producers, struggle with how to attract the interest and support of the public. In the area of national wetlands policy there have been notable successes. From the 1950's- to the 1970's, wetlands were being lost at a rate of a half million acres a year. That trend has diminished and even been reversed in some parts of the country. This was partly due to the creation of wetland maps, publicity about wetland losses, and the identification and elimination of federal policies that provided incentives to destroy wetlands. The goal of 'No Net Loss' of wetlands has gained support with the public and there is now broad acceptance that wetlands are important for storing flood waters, sustaining wildlife and serving as natural kidneys that clean up pollution.

'No Net Loss,' is also a term that many wetland professionals are not sure whether they should love or hate. It's a concrete, easy to understand goal, but as always the devil is in the details. Number crunching to accurately track gains and losses has been challenging. There is a natural tendency to overstate gains by agencies, nonprofits and other organizations. The goal has also supported the establishment of national mitigation policies that move wetlands around like checkers on a checkerboard—destroying one wetland here in return for creating or restoring another wetland there. Studies about mitigation success have raised questions about the consequences of moving wetlands to other parts of the landscape as well as the quality of those replacement wetlands. http://www.conservationmaven.com/frontpage/2009/12/4/mitigation-transforms-streams-and-wetlands-at-landscape-leve.html

It is possible to change public opinion and public policy. But it's not easy. Why? Well part of the problem is that floodplain and wetland managers are frequently incomprehensible to the general public. They use lots of terms that no one understands. In addition scientists are taught to provide detailed descriptions of their methods to prove the validity of their results. The public on the other hand is interested in results and what to do about them. In other words 'they need a story.'

Eric Eckl author of the website *Water Words that Work* has spent a lot of time examining effective communication about water issues and he shares some important findings on his website http://waterwordsthatwork.com/# .

Below is a recent post from the website with links to the key steps he provides an example of effective communication.

**A Kick %$#@! Video from the Pacific Northwest**

January 26th, 2010 | Author: Environmental Writing Guy


If you need to inspire people to step up to the plate as citizens and voice their support for nature protection and pollution control, take a look at this cheap, homegrown video from the Cascade Land Conservancy. It's fun to watch and makes its point clearly and cleverly. It's a winner!

Here's the "environmental message" rundown:

- **Step One: Begin with Behavior.** Check! Write, call, and visit your elected officials to voice your support for conservation. http://waterwordsthatwork.com/the-method/step-one-begin-with-behavior/

- **Step Two:  Foolproof Photos.** Check! There he is, writing, calling, and testifying, just the like the viewers are supposed to do. http://waterwordsthatwork.com/the-method/step-two-find-foolproof-photos/
- **Step Three: Swap the Shoptalk.** Check! No shoptalk anywhere. http://waterwordsthatwork.com/the-method/words-that-dont/
- **Step Four: Insert the Words that Work.** Check! Basically, the only words in the whole piece are "Make a Difference." http://waterwordsthatwork.com/the-method/words/

The video by the Cascade Land Conservancy tells a story. It contains the environmental message method that Eric has been advocating for a number of years.  He's not alone.  The Goodman Center also has some useful free publications about storytelling as best practices and why bad presentations happen to good causes: http://www.agoodmanonline.com/publications/index.html

It's not enough to provide people with facts and figures. The message has to understandable and compelling and people need to know what they can do. Stories are an effective way to communicate. They are an enjoyable and effective way to learn.

Changing communication style and focusing more on sharing information through stories is not a silver bullet.  It won't remake public opinion overnight.  It's hard to transform scientific studies and engineering models into accurate explanations in the context of a story. It requires learning new skills and it takes time. But stories have universal appeal.  They can reinforce respectful dialogue with all interest groups.  Stories provide a way to connect and move forward.  Then positive action can lead to positive change.

# NPDES AND NFIP—LESSONS LEARNED ON PUBLIC EDUCATION AND OUTREACH

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Among the many federal programs that have an impact on local governments, the Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System (NPDES) and the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP) can have the most dramatic effect on local water resource programs. Is now the opportunity to compare the similarities and differences of these federal programs to leverage institutional knowledge? This brief paper is intended to only question one of many components of these two programs – public information, education and involvement.

The NPDES is not voluntary. Because of the Clean Water Act, numerous communities that are urbanizing or have a minimum of 100,000 residents are required to have an NPDES permit with six minimum measures: Public Education and Outreach, Public Involvement and Participation, Illicit Discharge Detection & Elimination, Construction Site Management, Post Construction, and Pollution Prevention. The intent of the NPDES permits is to require communities to use the six broad measures whereby a comprehensive approach is developed and implemented reducing pollutant-loading to streams from non-point source pollution.

The NFIP is a voluntary program. In the more than 20,000 communities across the US that have adopted and enforced floodplain regulations, residents of those communities have the privilege to purchase flood insurance. In addition, federally-backed mortgages are available in NFIP communities to satisfy the flood insurance purchase requirement for properties in the floodplain. The primary intent of the NFIP is to reduce flood damages. There is an additional voluntary program within the NFIP called the Community Rating System (CRS). Approximately 1,110 communities participate in the CRS so that flood insurance policy holders receive discounts on their premiums. To receive CRS credit, communities must go beyond the minimum requirements for the NFIP and adopt a comprehensive approach to managing floodplains. One of the four activities in the CRS where significant CTS points are awarded is Public Information.

For many communities the administration of their NPDES permit, NFIP (floodplain ordinance and regulatory maps) and CRS activities occur within the same department or division. This provides insight into many high-level comparisons between the federal programs. The NPDES is a mandated permit with structure that leads to a comprehensive approach to improving water quality. The NFIP and CRS are voluntary programs that are regulatory and incentive based, respectively. Relatively few communities elect to participate in the CRS and its multi-objective holistic strategy to reduce flood losses. Therefore, maybe it is time to ask ourselves fundamental questions as water resource professionals:

- Overall, what can be learned or messages leveraged between NPDES and NFIP as to possible minimum requirements or additional incentives, levels of local participation, the comprehensive approach and effectiveness of exceeding set goals?
- Would the NFIP be more effective if additional program elements or a comprehensive planning approach was mandatory as part of joining the NFIP?

- Instead of primarily relying on the NFIP at the national level for education and outreach, should there be a minimum outreach requirement at the local level for communities wishing to join the NFIP? Baseline flood insurance outreach at the local level could educate and engage residents of each NFIP community. Communities that go beyond an NFIP minimum for outreach and education could be credited under CRS.

NPDES permits have been in existence for over 10 years. The NFIP is becoming increasingly exposed to water quality issues as a result of lawsuits that pertain to endangered species. Maybe now is the time to compare these federal initiatives, weighing the benefits and effectiveness of mandatory public education and outreach at the local level.

# FLOOD RISK COMMUNICATION AND THE INSURANCE AGENT

**Bruce A. Bender**
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Talking about risk is not uncommon for an insurance agent (broker and/or an agency's customer service representative (CSR)). Every day, they are talking with clients and prospects about their risk related to fires, theft, injury, auto accident, etc. and how to financially reduce that risk through the purchase of insurance. Yet, one of the more prevalent risks for which a property owner is not protected by insurance is the risk of flooding.

While there are conscientious agents who routinely discuss the risk of flooding with their clients and prospects and do offer and promote flood insurance – and even use a declination or waiver form that the insured signs when they don't purchase it – many agents today still do not actively market, promote or sell flood insurance. Reasons for this include: low perceived risk ("it won't flood there") and it's too complicated and time consuming to write and stay up-to-date with all of the changes. However, this paper is not specifically about how to get them to sell more flood insurance; that is a bi-product. For the betterment of the community, state and nation, insurance agents need to become more engaged in better understanding and communicating the risk of flooding; and the communities/counties, Cooperating Technical Partners (CTPs), states and the Federal Emergency Management Agency (FEMA) need to help more in this area.

**Map Mod to Risk MAP**

FEMA's Flood Map Modernization effort brought new digital flood maps to the nation, which in many cases resulted in properties being mapped into or out of high-risk areas or having changes in their Base Flood Elevations. With the transition now to FEMA's Risk MAP (Mapping, Assessment, Planning) program, there will be greater emphasis on assessing and planning; however, remappings will still continue and boundaries and BFEs will continue to change. Consequently, the insurance industry must be actively engaged in any outreach effort and tools provided for them to successfully communicate changes in flood risk to their clients and prospects. Sadly, experience indicates this does not happen as frequently as it should.

For example, when a public meeting (e.g., Flood Risk Open House) is held for the local citizenry to view the new preliminary flood maps, the majority of the attendees end up having three questions:

1. How am I affected?
2. How do I get out of it (if they find they are mapped into a high(er)-risk zone?
3. What's the cheapest amount I can get it for (i.e., what's the cost)?

As a result, they will be contacting their insurance agent to learn more about the effects and their options. Therefore, it is important that the agents are engaged earlier in the mapping lifecycle to ensure they understand – in advance of receiving calls and visits – why and what areas were remapped, where and what changes will be occurring, the project timeline, what options are

available (i.e., grandfathering, conversion), where to go for more information, etc. Engagement could include meeting with local agents and/or their associations; offering training via the NFIP Training contractor or other source; providing updates for their association's enewsletter; or providing updates via email. Properly informed and trained insurance agents can be a powerful ally in successfully introducing new flood maps, explaining the changes in flood risk and what options are available.

**Preparing the Agents**

Insurance agents need help. They need help understating how to write a policy and it needs to be made easier. For many, it's so complicated that they do not want to sell it, so they will not even talk about the flood risk. They also need help better understanding what the real flood risk is and how to better communicate it.

With the advent of the NFIP Marketing Campaign, FloodSmart, more tools have become available (e.g., several toolkits at http://www.FloodSmart.gov; agent tools and resources at http://www.Agents.FloodSmart.gov) to help insurance agents be better prepared, properly respond to barriers and myths that property owners have about their risk and flood insurance, and help the agents market and sell more flood insurance. But even more sophisticated tools and visual aids are needed to help the agent understand the risks better and to then be able to more clearly explain it to their clients and prospects. The Risk MAP program is proposing to explore new ways to visually illustrate the flood risk differently than just a line on a map - which is interpreted by many to represent the "in or out" or the "it'll flood or I'm safe" line. As these tools are created, the insurance agent needs to be kept in mind so the tools are designed such that they help them understand the risk better and explain it easier.

As mentioned earlier, writing flood insurance is not easy; it is probably THE hardest coverage to write as it is nothing like any other line of insurance. And agents are commenting that in just the past few years, FEMA seems to be making it more complex than easier. If the program was less complex, more agents would feel more comfortable selling it and hence more would be talking about the risk of flooding with their clients and prospects. In the meanwhile, to help the agents be more comfortable with the every changing rules and rates, the agents need more training, both at the introductory level as well as advance level. FEMA needs to create a more robust and easily available training program. Likewise, *all* states need to strengthen their continuing education (CE) requirements (i.e., require 8 hours of CE) such that flood insurance training is mandatory not only to get their property and casualty license, but to maintain it. Incorporated in that training should be a section on flood risk and on how to communicate flood risk (not sales, as most states do not allow credit for presentations that include sales or marketing).

**Risk Communication Pays Off**

When heavy rains appear, flood disasters happen and/or map changes occur, property owners turn to their insurance agent to ask about their flood risk and flood insurance. With better training (and CE requirements) and more sophisticated (yet user-friendly) tools, insurance agents will be more confident and capable in talking about flood risk and hence recommending flood insurance, whether the property is in a high-risk or moderate- or low-risk zone. As a result, more property owners will better understand their risk and become protected, property owners and communities – as a whole – will recover more quickly from flooding events, and the amount of disaster aid provided will be reduced.

# DISPARITIES IN FLOOD RISK COMMUNICATIONS

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The people that reside anyplace where floods occur or are projected to occur on any sort of a regular basis talk and communicate about floods and flooding. But, depending on their place in the flood society, they speak and communicate about floods in a different manner. Some are well-informed and know some of the science of flooding while others rely on first-hand experience or community lore to communicate their knowledge of the subject. And others might simply reiterate the rules and regulations their particular agency has placed before them to interpret and use as a regulatory basis for managing floodplains. When considered in total it is no wonder that there always has been, continues to be and likely will be disparities in how flood risk communications are made and understood.

There are several agencies and offices at the federal level that are directly involved with communicating flood risk and providing one or more services related to floodplains, flood relief and flood mitigation. The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP) as well as several flood mitigation programs. FEMA is also directly involved in disaster relief following presidential disaster declarations. They perform these functions through their relatively small departmental staff and through the individual state offices headed by the NFIP state coordinator. The U.S. Army Corps of Engineers also is closely involved with flood risk communication through their various flood mitigation programs and a national levee inventory and inspection program. Other agencies such as the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS) also communicate flood risk, particularly relative to prediction.

Each of the above federal agencies has a direct and implicit role in the communication of flood risk. In many instances, the terms and definitions used by these agencies are dissimilar. Why? Primarily because each agency has a different mission and a different goal that they have been mandated to fill. Definitions have evolved over time within a given agency throughout its administrative lifetime. Thus, their manner of communicating flood risk varies tremendously. They perceive that they are communicating their flood-related information in a good, concise, understandable manner to the people that need their information. But, in fact, this is not the case. The manner and content of flood risk communication is also highly dependant upon the recipient or target of this information

The federal agencies must communicate with their own staff as well as other federal offices and they must communicate with their "clients", often individual citizens and property owners. This is most often accomplished through the various state agencies with, in FEMA's case, the state NFIP coordinator. The states, then typically communicate with local communities as well as individual property owners. And each state is set up and organized in different manners with departments responsible for communicating flood risk housed in different state offices that have, in many instances, dissimilar roles and certainly dissimilar budgets with which

to carry out their functions. Thus, flood risk communications are then made, with varying degrees of expertise and overall knowledge, to local communities through the state office responsible for floodplain management. The local communities receiving this information, in the form of memos, letters, ordinances, building codes, flood maps (Flood Insurance Rate Maps, Flood Hazard Boundary Maps, Special Flood Hazard Maps, D-Firms and Firmettes—and the list goes on) and Flood Insurance Studies are then expected to know, understand and interpret this information to property owners within their political jurisdictions. Many local communities such as Los Angeles, St. Louis or Boston to name only a few, have large, highly train staff that are comfortable in utilizing these data. Other, less populated communities with few resources, likely a telephone, a fax, a computer and a printer might be staffed with someone who's only knowledge about flooding and flood risk communication might be history and local lore if they've lived in the area long enough. Their office hours might be from 10 a.m. to 2 p.m. on Tuesdays and Thursday. Yet they are expected to communicate flood risk in the same manner and with the same expertise as the staff from the City of Boston!

If we haven't already laid the groundwork for showing where there are disparities in flood risk communication let us consider how such offices or businesses as the local lending institution, property insurance agent or realtor handles such information. From firsthand knowledge, it has been observed that realtors do not take floodplains into account when they are in the process of showing property. Most do not even know how to gain access to the information when it is only two mouse clicks away. Many insurance agents are equally poorly informed and only become involved when a title company, bank or property owner comes to purchase flood insurance because some flood determination company 500 miles away looked on a map, saw a floodplain and said the property was prone to flooding.

The way this information is received, internalized and communicated varies with each of the above communicators. FEMA, for instance, has programs to "educate" all of their client groups, i.e., state coordinators, lending institutions, realtors and local government representatives. But these communications are all in the language spoken by FEMA. They are not written and communicated in Bostonian or rural townshipese. Nor are they even in the same language as other federal agencies. This is likely to continue until a national communications assessment and overhaul is completed in the field of hazard communications.

Consideration must be made at the federal level to evaluate the manner in which hazard communications are defined and communicated. Whether or not a formal Department of Risk Communication is needed is questionable, but should not be dropped for lack of consideration. And, the findings must be passed on to state and local governments so that they can speak the same language. In fact, to facilitate this happening the framework for this type of initiative must be laid not only by federal representatives of risk-related agencies but by representatives of their counterparts at the state and local level.

# MANAGING RISK TO HUMANS AND FLOODPLAIN RESOURCES: HOW DO WE GET FOLKS TO "JUST DO IT"

**Greg Main**
***Association of State Floodplain Managers and Indiana Department of Natural Resources***

As we prepare for the Third Assembly of the Gilbert F. White National Flood Policy Forum it is my hope that one of our ultimate goals will be to establish national policy and standards that will result in a safe, and informed public that understands their risks in regards to flooding. As a group, we can develop a plan that will result in sustainable systems that the public will want to support when it comes to how they interact in our nation's floodplains. We all need to work toward a strategy for communicating flood risk to the public and to decision makers about the actions that are needed to more proactively manage the nation's flood risk and its floodplain resources.

At present, it has been my experience that we are not getting thru to the public on getting them to "buy in" and accept that there is a risk from flooding. Having worked many floods in my home state of Indiana, I have had many conversations trying to convince flood victims that they need to consider doing different approaches in their reconstruction efforts instead of simply building or re-building exactly the way they were before. Getting them to "Just Do It" seems to be a scenario that most individuals do not want to accept when it comes to understanding their flood risk. The challenge is how to break down that reluctance to "buy in" to accepting the flood risk and take appropriate actions to mitigate against flood losses.

How we communicate flood risk is critical to the way we as professionals relate to the public and media on floods and flood risk. There needs to be more outreach to the public and a major communications effort is needed. Simply providing the public with improved flood maps does not necessarily guarantee that the public will accept that they are at risk. In fact, in many cases it has been my experience at public meetings where we present new flood mapping to a community, we find that most of the public does not agree with the new maps if they are shown as being in the floodplain. The public's current understanding and acceptance of the peril is not the same as, say risk of a fire. Getting the public to understand that everyone is at some level of risk to flooding is the first step needed to begin the process of "buy in" to managing flood risk.

Perhaps now is the time to re-think how we present flood risk to the public. Some thoughts that have been floated around have been such things as: requiring flood insurance as a part of all homeowners policies; adding a series of zones within SFHA so those more at risk pay higher rates than those at a lesser risk i.e. a graded zone system; having more areas of mandatory flood insurance coverage such as residual risk areas on rivers and coasts including insurance for structures behind levees.

Communities should be encouraged to use higher development standards at the local level. Examples of such standards are freeboard, zero rise floodways, no residential uses in floodway,

establish no build zones in coastal highest hazard areas. We should also have disaster dollars tied to NFIP compliance, and develop a sliding scale to reflect how well a community or state is managing their flood risk. We should also encourage incorporating the aspects of the natural and beneficial functions of floodplains as a positive economic benefit to local communities and educate the public to support such measures. This approach could be factored into incentives. For example, the more a community does to preserve natural floodplain resources, the more those natural functions will reduce flood losses and disaster costs. So it makes sense to reward a community up front for reducing floods, rather then reward them with disaster payments after the flood.

Until we get those who live and work in areas at risk of flooding to start "buying in" to the process, we are going to continue the cycle of build, disaster, and bailout over and over again. Instead we need to continue to push to move to a more comprehensive flood risk management approach that more effectively communicates the risk and does so in terms that can be accepted by the public.

# Part 3

# Management Strategies—In Place and Envisioned

# FLOOD RISK REDUCTION WITH WETLAND RESTORATION OF THE MISSISSIPPI RIVER DELTA

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Coastal Louisiana—and by extension the nation—is preparing for the next big storm. Across the coast, levees and roads and natural features will provide storm surge reduction and protection for 10% of our Nation's economy, which is generated in coastal Louisiana. For the greater New Orleans area, construction and planning of civil infrastructure for storm surge protection is active. By 2011, the Corps of Engineers will provide 100-year protection, largely in the form of improved levees, surge barriers, and floodwalls. There is serious criticism that this standard should be elevated to a 400- or 1000-yr storm return period—Hurricane Katrina was a 400-yr event (NRC 2009). In addition to structural improvements using built infrastructure, *strategic wetland creation must become an integral component of long-term risk reduction, also referred to as natural infrastructure*. Currently, there is no unified integrated plan of protection and restoration, between the state and the Corps, to engineer the river and its sediments for strategic delta wetland creation, while accommodating navigation and flood protection.

Risk reduction for New Orleans has been a reactive approach; following a storm flood, levees are raised to the scale of the last event. Social inertia settles in during flood hiatuses, and society ignores those ever increasing risks as subsidence continues, sea level rises, and the threat of tropical storm activity increases. While sea level rise and subsidence are rather incremental in nature and can be monitored and forecasted, future storm frequency and intensity is uncertain. We have no reason to assume that storm frequency or intensity will decrease as global temperatures increase; rather, the opposite is likely (Emanuel 2005). At the same time, there is incremental loss of wetlands and coastal landscape within the seventh largest delta in the world, largely due to abandonment of the river to its floodplain. Predictions vary about the level of land loss expected over the next century, but it is certain that increased exposure of people and infrastructure to coastal inundation is associated with this change in land to water landscape. It is the role of policy makers to inform the public and implement progressive risk reduction strategies to minimize property and human loss in New Orleans and the greater coastal Louisiana area.

No other area of coastal Louisiana has such an immense potential natural energy to create significant delta wetlands than the Mississippi River near New Orleans. It is clear that the lifespan of engineered protective barriers also hinges on the breadth of wetlands that reduce storm surge and wave energy. To this end, we believe the scientific evidence and engineering potential can design, in the near-term, large-scale controlled diversions of the Mississippi River to accomplish a self sustaining delta of a certain size. These diversions will form a critical phalanx of wetlands for surge reduction. What is our plan for strategic landbuilding to protect New Orleans?

The National Research Council (NRC) reviewed the Louisiana Coastal Protection and Restoration Program (USACE, 2009), which was intended to be the Corps' comprehensive analysis and design for flood control, coastal restoration, and hurricane protection (NRC 2009). The NRC concluded:

> The lack of a comprehensive long-term hurricane protection and coastal restoration plan, and the lack of advice on initial high-priority steps and projects, represent substantial shortcomings of the LACPR draft final technical report… the Corps of Engineers and the State of Louisiana should agree on the elements of a single comprehensive plan for long-term hurricane protection and coastal restoration. As part of that plan, the Corps and the state should agree on a number of high-priority projects for immediate implementation.

**Points for Forum Discussion**

The NRC proposed the following key recommendations for the LACPR Program that are relevant to engineering and wetland restoration. These topics can serve as points of discussion for the forum. Following each recommendation is commentary or a question as a starting point of discussion.

1) *Storm surge protection for the City of New Orleans should be designed for a hurricane storm surge event with an expected return interval of 400 to 1,000 years.* Long-term structural improvements to protect New Orleans must include strategic wetland restoration with river sediments. The one-sided approach of increasing structural height without an apron of protection, in the form of wetlands, will have significant cost to society over an engineering timescale.

2) *Rather than focusing energy and resources into trying to maintain the current configuration of southern Louisiana's eroding coastline, the LACPR Program is encouraged to focus its protection and restoration plans on high-priority projects.* New Orleans is clearly a vital area given it importance to commerce. It also has the river nearby that can be optimized for sediment delivery and wetland building.

3) *The LACPR program should complete a sediment budget for coastal Louisiana. They also should provide a better explanation of potential costs and environmental impacts of dredging alternatives.* The Mississippi River now carries one-half the sediment load it had in the 1950's. This reduced load limits wetland restoration and the footprint of a self-sustaining delta. What are the implications of this 'map' of a future coastal Louisiana.

4) *The LACPR program should provide a better and more quantitative explanation of the scientific uncertainty associated with projections of marsh and wetlands restoration (including diversions), surge attenuation by wetlands, numerical modeling efforts, and*

*the implications of Mississippi River diversions.* The science of predictive modeling and knowledge of the landscape is rapidly improving. Here scientists, engineers, and industry can reduce uncertainty.

**Can Engineering and Science Design Large-scale Delta Wetland Restoration Projects?**
The Mississippi River provides society with the natural example of its ability to build land—even when we don't design it that way. A flood relief outlet was dredged from the Lower Atchafalaya River (the Mississippi's major distributary) to keep Morgan City from flooding. At the mouth of the outlet formed a delta—the Wax Lake delta—which has grown some 85 $km^2$ of wetlands over several decades. The outlet was never designed as a sediment diversion but has demonstrated the land building capacity of the Atchafalaya River. Using the Wax Lake delta as an analogue of coastal deltaic processes, Kim et al. (2009) developed a model that predicted the potential growth of a delta under different scenarios of sea level and subsidence. This model can be applied to project the growth of similar deltas with the construction of new sediment diversions on the Mississippi River. The authors estimate that 1,000 $km^2$ of new wetlands could be built within a century under a base sea level rise of 2 mm/yr and subsidence of 4 mm/yr. Today's physical and numerical models have improved our predictive knowledge of delta morphodynamics and how deltas may compensate for sea-level rise and subsidence (Edmonds and Slingerland 2010; Parker et al. 2006). These tools have advanced our certainty of potential delta land building conditions of the Mississippi River, given the constraints of present sediment supply (Meade and Moody 2009; Blum and Roberts 2009).

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Figure 1. Growth of the Wax Lake (left) and Atchafalaya River (right) deltas since the 1973 flood. The Wax Lake Delta serves as a natural example of wetland building that can take place with Mississippi River diversions.

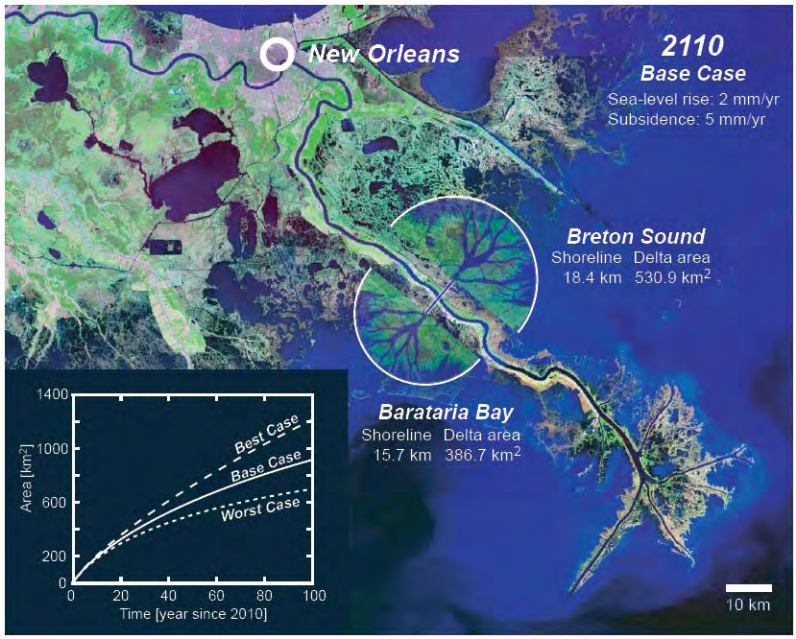


Figure 2. The land-building model proposed by Kim et al. (2009) that projects 1,000 km$^2$ of new wetlands that can be created with controlled Mississippi River diversions.

# MINIMIZING RISKS IN A FLASH FLOOD ENVIRONMENT

**Gale Wm. Fraser, II**
***Clark County Regional Flood Control District***

The Clark County Regional Flood Control District (District) was created in 1985 and prior to constructing drainage improvements we were tasked, by state law, to develop a comprehensive master plan for the control of floods. This plan required the most effective structural and regulatory means for correcting existing problems of flooding and addressed the probable effects of future development. The region served by the District is an arid area that averages four inches of rain per year. In the past, storms have produced three inches of rain in 90 minutes in a valley surrounded by mountains that discharge onto steep alluvial fans, all equating to a flash flood environment. Adding to the natural environment that produces flash floods, further exacerbating the problem is the unprecedented growth Clark County has experienced over the past decades. The challenge posed requires structural, non-structural and personal responsibility to address these unique flood hazards and minimize flood risk to the public.

The District also developed uniform regulations for drainage and drainage criteria. The regulations exceed FEMA's minimum standards (lowest floor must be eighteen inches above the 100-year water surface). The criteria define the policies and technical requirements necessary to develop the design storm and calculate hydraulic characteristics of the drainage network. The master plan, regulations and criteria must be adopted by our member entities and adhered to in order to obtain eligibility for District funds. Any land improvements that have regional significance, defined as adjacent to a planned or existing regional flood control improvement or located in a 100-year flood zone cannot proceed until the member entity obtains District concurrence.

To date we have overseen the construction of 82 detention basins and 420 miles of improved channels and underground storm drains at an investment of $1.5 billion. This investment is necessary to pass flows through an urban area in a non-damaging manner, while also taking into account possible future development. While we have a master plan that is primarily structural, where natural systems exist that can convey the flood flows safely, they will remain natural.

The District has witnessed improved channels rising 7 feet in 8 minutes, detention basins rising 14 feet in 14 minutes and velocities that have caused considerable erosion in natural washes. Those conditions, along with the following reasons, are why we have structural solutions in our environment:

1) Prior development was at or near the downstream ends of water courses. The ability to handle flood flows through existing urbanization is hampered by limited rights-of-way.
2) Steep alluvial fans exist that have undefined flow paths upstream of development and require structural solutions to capture the flood flows at the apex and ensure delivery to the downstream network in a controlled manner.

Eight major washes drain the valley all converging on the Las Vegas Wash – the longest wash that crosses the community from the far northwest to the southeast and empties into Lake Mead,

our primary source of drinking water. This community recognizes the importance of preserving the 'natural' environment by keeping the lower six miles of the Las Vegas Wash as 'natural' as possible by planning more than 22 grade control structures to minimize erosion, an effort done in combination with re-vegetation and invasive plant management. To date 11 structures have been built, two are under construction, and nine remain to be constructed. While really a structural solution, it has the appearance of a 'natural' solution. The results to date have reduced Total Suspended Solids (TSS) by 60 percent and when completed it is estimated that TSS will be reduced by 80 percent. This project is successful in our environment because of vast public rights-of-way with no development in the surrounding area.

As important as structural and non-structural solutions are to managing the flood risk, equally important are the personal actions residents must take to protect their lives, homes and businesses. In an effort to keep people away from flood water, promote the benefits of flood insurance and care for the stormwater environment we have developed a comprehensive public information program. This outreach effort includes billboards, a government access television/news program, public service announcements/commercials and school/civic presentations (see www.regionalflood.org).

One challenge we continue to face is people are confused about flood insurance. From our 2009 survey of 840 residents (margin of error ± 3.4%), 8% said they lived in a flood zone, 45% said they don't live in a flood zone, and 47% didn't know. Of the 8% (67 respondents) that said they live in a flood zone, only 15 of those said they carry flood insurance. While it is true that if you do not have a federally-backed mortgage you are not mandated to carry flood insurance, it is unlikely that the remaining 52 people (who said they don't have flood insurance) have paid-in-full mortgages. Likewise, of those 45% (378 respondents) that said they do not live in a flood zone, initially 45 said they do have flood insurance. In both instances, once we defined what flood insurance actually covers, consistently people changed their answer to say they have flood insurance. We continue to seek ways to address this confusion and allow the public to make informed decisions on how they approach managing the flood risk.

A holistic approach needs to be taken to minimize the flood risk to the public. This includes master planning, resources to implement the plan, regulations, criteria and public outreach. All available means, be it structural or non-structural, need to be utilized. The partners in this effort include the public and government. The plans and programs need to address the environment where they are located. While there is value to 'natural' floodplains, there are locations where historical actions make this solution impractical. No doubt that if our community possessed the knowledge we have of flood hazards today in the 1900s the landscape of Southern Nevada would look much different. One size/solution does not fit all; we have to play the cards we are dealt when managing the flood risk.

# COMPREHENSIVE FLOOD RISK MANAGEMENT APPROACHES

**Susan Gilson**
***National Association of Flood and Stormwater Management Agencies***

The National Association of Flood and Stormwater Management Agencies (NAFSMA) was established in 1978 to address urban flood management issues. In the late 1980's what was then the National Association of Urban Flood Management Agencies became NAFSMA since many of its member agencies were taking on the responsibilities of the new national stormwater management program which was being established under the National Pollutant Discharge Elimination System (NPDES). The authority for the NPDES stormwater program was provided by Congress under Section 402(p) of the Clean Water Act. As a result of its mission, NAFSMA focuses on water quantity and water quality issues as well as flood risk management and floodplain protection.

Addressing flood risk management through a comprehensive multi-objective approach brings our member agencies many unique opportunities and challenges. Many of our members have implemented a combination of structural and non-structural approaches to flood risk management. Most of those structural flood risk reduction projects were taken on by local agencies in partnership with the federal government after a national interest was determined and detailed cost analyses proved these projects to be a beneficial use of local, regional and federal resources. Many of those projects were constructed to provide flood damage reduction to urban areas and still provide a critical function in our nation's cities.

At the same time that these structural tools have been utilized, so has a tool box of non-structural approaches ranging from flood insurance, emergency planning, successful flood risk and water quality educational outreach campaigns at the local and implementation of local and federally-partnered flood risk mitigation projects. It is this combination of strategies, or tool box, that makes our local, regional and national flood risk reduction efforts successful.

One of the most important aspects of a comprehensive flood risk management toolbox is the need to provide flexibility. This flexibility is vital to meeting varying flood risk management needs throughout the country, since geographic and hydrologic needs differ throughout the country. Flexibility is also needed to address existing infrastructure and new infrastructure needs. A one-size-fits-all, top-down approach will not provide us with effective flood risk management.

Although successful flood risk management needs to happen at the local and regional levels, there needs to be a federal commitment to address these issues in conjunction with the local agencies responsible for their operation and maintenance of our structural tools as well as technical guidance provided to meet evolving federal requirements both in the flood damage reduction and environmental arenas.

Many of the flood damage reduction projects fall under the umbrella of aging infrastructure and some are being utilized well beyond their original project life design. A good number of these projects were constructed in advance of current environmental laws and requirements. As a result, there needs to be a federal commitment to address these issues in conjunction with the local agencies responsible for their operation and maintenance. If a liaison approach can't be developed among state and federal agencies charged with environmental and flood risk management responsibilities, how is a local agency expected to navigate these channels? While many local agencies are committed to protecting their water and other natural resources, it is often difficult to navigate the channels of conflicting federal requirements. While one federal agency requires an agency to take a certain approach, another federal agency with its own mission often tells local officials to take another course of action.

In the last five years, the U.S. Army Corps of Engineers and the Federal Emergency Management Agency have made great strides to speak with one voice on critical flood risk management issues and to address what can at times seem like conflicting missions. The commitments of these agencies have moved flood risk management ahead in very positive direction.

It is NAFSMA's hope that this approach can be carried to other federal agencies, in collaboration with local, regional and state agencies. While a unified federal voice can provide consistency, it can also lead to unintended consequences at the local and regional government levels. It is critical that the local perspective be well-represented at the table as these new federal approaches are developed not only to avoid a top-down approach, but to provide for stronger, more successful flood risk management programs at the local, regional state and federal levels.

# COMMUNICATING FLOOD RISK AND RESPONSIBLE FLOODPLAIN MANAGEMENT: HELPING COMMUNITIES RECOVER IN A POST-DISASTER WORLD

**Ann Terranova**
***URS Corporation***

The experts invited to the Third Assembly of the Gilbert F. White National Flood Policy Forum have been asked to prepare a paper that summarizes our thinking related to the 2010 Forum topic *"Managing Risk to Humans and Floodplain Resources."* In particular, we have been asked to explore the challenges in developing and implementing a comprehensive, effective strategy for managing flood risk and floodplain resources in the future. Opportunities abound to leverage the foundations already established by existing initiatives and programs at all levels – federal, state, and local – to effectively manage flood risk and protect floodplain resources in the face of future disasters. One could argue that an important building block in achieving success in managing and reducing risk is an effective risk communications program.

To illustrate, FEMA, through its Disaster Assistance Directorate's Long Term Community Recovery Program, has undertaken an important mission to aid communities in effectively recovering after catastrophic events. "Effective" is the operative word – by educating and informing communities about the risks associated with living in high hazard areas throughout the country, FEMA is undertaking a process that empowers communities to make decisions about their long term recovery in a responsible manner. Key to this process is an integrated planning approach with the floodplain management community *at all levels* – federal, state, and local – so that risks are minimized and communities are better protected from the hazards associated with future disasters. Provided below is a snapshot of one technique used by FEMA and the City of Galveston to communicate flood risk through its Long Term Community Recovery planning process.

**The City of Galveston: A Case Study**

Hurricane Ike made landfall in Galveston, Texas on September 13, 2008. In its wake was devastation never experienced by the community. On November 20, 2008, the Galveston City Council began the process of appointing members to the Galveston Community Recovery Committee (GCRC). This appointment process finished six weeks later and resulted in a committee that included 330 Galveston residents. Galveston City Council wanted to be certain that diverse voices and new ideas were represented in this process. Committee meetings were subject to the requirements of the Texas Open Meetings Act and always included an opportunity for the public to address the committee formally and to participate in committee meetings informally.

FEMA, in collaboration with the GCRC, engaged in a comprehensive planning process that involved active participation by the citizens of Galveston to ensure a future that took into account the risks associated with living in a high hazard coastal area. Immediately after the GCRC was formed, members quickly agreed on three guiding principles:

- To build upon and retain what made Galveston a quality place to live, visit, and own a business;
- To develop a Long Term Community Recovery Plan to lead Galveston to a better place that was safer than it was before the disaster; and
- To make sure the Recovery Plan addresses every aspect of life in Galveston.

***The GCRC began its work by listening to fellow Galvestonians…***

The recovery planning process was on an extremely tight time frame, with the Recovery Plan due to City Council in early April, 2009. With the guidance and expertise of FEMA's Long Term Recovery Team, the GCRC determined it needed to take the time to listen carefully to the citizens of Galveston. The Committee engaged in a public outreach program that included a series of ten open houses. These meetings were held in various locations, including two off of Galveston Island, and provided the public with an opportunity for face-to-face discussions with GCRC, City staff, and FEMA Long Term Recovery Team members. Over 800 people attended the open houses and more than 2,700 comments were collected through post-it-notes, surveys, and comment cards.

Committee members also conducted surveys and focus group meetings independently. Public input was used by GCRC to identify recovery issues and concerns and formed the foundation for five recovery focus areas: the environment; economic development; housing and the character of the community; health and education; transportation and infrastructure, and disaster planning. The committee divided itself into five focus areas, 13 work groups, and finally, into 42 project teams. Committee members were heavily involved in the writing and development of the projects. This hands-on involvement helped to support ownership of projects and facilitated a strong community bond. Integral to this process was the active involvement by the local Floodplain Management Administrator, the City's Planning Department responsible for ensuring that the tenets and principles of mitigation planning were infused throughout the recovery planning process, state officials, and FEMA.

What resulted from this highly interactive and engaging process was a Long Term Community Recovery Plan for the City of Galveston that the community felt reflected their priorities for ensuring a safe and economically viable future.

***Answering the "so what" question…***

By now, you're thinking *what does this have to do with our task at hand at this Third Assembly?"* I offer the Long Term Community Recovery Process as a jumping off point to illustrate the need to continue in our efforts to more fully integrate initiatives that we don't often think of as obvious in helping us achieve responsible floodplain management – *where risks are understood, and people take action to reduce their own risks.* In the case of Galveston, because risk reduction was a criteria for prioritizing recovery projects, this helped the GCRC frame its future based on understanding risk and taking actions to prevent future loss of life and property.

***The Draft National Recovery Framework…***

On February 5, 2010, FEMA, in coordination with the interagency Long Term Disaster Recovery Working Group, issued a draft of the National Disaster Recovery Framework that is *"focused on engaging state, local and tribal governments, nonprofit partners, the private sector, and the public to enhance the nation's ability to recovery from disasters."* This is especially important in the floodplain management community, because from a national policy standpoint at the highest levels, most, if not all of the focus has historically been on response. The National Recovery Framework, which in part, looks at recovery from a long term perspective (and provides the underpinning for *effective* long term community recovery), provides the opportunity to affect behavior change as it relates to real and perceived risk. It also has the ability to encourage action at all levels that ultimately results in safer, more resilient communities, post-disaster, that take into account risk.

I envision that this is yet another avenue where Symposium members can offer valuable insights on flood risk from a policy perspective, and help to affect much needed behavior change. It also provides even more opportunities to integrate approaches to effectively managing flood risks into the coming decades.

# FLOOD RISK IS NOT FLOOD RISK IS NOT FLOOD RISK

**Warren D. "Dusty" Williams**
***Riverside County Flood Control and Water Conservation District***

Before we can effectively manage flood risk, we must determine what those risks are. Too often we rely exclusively on the "usual suspects" (i.e. probability, depth, velocity, etc.) and fail to address the regional characteristics adequately. Floods in the southwestern part of the United States are vastly different from those that impact the upper mid-west – neither one is necessarily better or worse than the other, just different. And it therefore follows that so too are the associated flood risks.

All flood risk management strategies share the same basic goal – the protection of people and property from the negative impacts of flooding. It is the degree of flooding and the severity (both physical and non-physical) of the damage to the people and their property that are not standardized. All floods are not created equal and neither should the risk management strategies employed. In short, one size does not fit all.

As an example, some believe that no new levees should ever be constructed to facilitate new development. The chief argument being that development behind levees is at a higher risk than development protected by other flood management techniques. When channels and underground storm drains are exceeded the result is flooding of the adjacent areas, but only by the excess flows.

Conversely, when levees are exceeded, the result can be the catastrophic failure of the structure itself and the exposure of the adjacent properties to inundation and damage from the entirety of the flood flows, not just the excess.

However, while the reality of increased risk associated with levees is inescapable, the consequences can differ broadly. There is no question that the effects of the levee failures in New Orleans (resulting from Hurricane Katrina) were devastating and it could be argued that it would border on criminal to create another similar situation. But, not all levees are, or need to be, constructed to deal with category 5 hurricanes, the Mississippi River or the California Bay-Delta system.

Some levees are built to confine and control shallow sheet-flow flooding; to handle relatively small flow rates; to manage debris laden flows (such as alluvial fans); etc. – in short, for a variety of situations that do not involve a river system. And while the failure of these levees is always a possibility, the result can be significantly less severe than with their riverine counterparts. Certainly property damage will occur, but often it is in the form of soaked carpets and muddy streets. The threat to life and limb, while possible, is far less probable. Public inconvenience is often the major byproduct. In the arid southwest we sometimes refer to this type of flooding event as a "rug-wetter".

In summary, each flood risk management situation is unique and needs to be judged, measured and reacted to based on its own distinctive character. While evaluating and communicating flood risks effectively and efficiently requires us to use a National approach, we must always be cognizant that generalities generally serve to confuse and miscommunicate. This is a large country with widely diverse geography, topography and weather situations and hence, widely varying flood risks. Our management (determination and communication) of those risks must recognize that one size does not fit all.

# COMMUNITY RESPONSES TO A SURVEY ON MANAGEMENT OF FLOOD RISK

**Claire Reiss**
***Public Entity Risk Institute***

In preparation for this paper, the Public Entity Risk Institute conducted an online survey of its constituents in January, 2010. The survey received 108 responses, primarily from emergency and floodplain managers. Most responses were from local and county government personnel, but some were from state personnel, and others were from private or educational entities. A copy of the survey form is attached to this paper.

The survey was about flooding so, as might be expected, 66% of respondents said their communities had experienced flooding in the five years; 79% percent reported having a significant number of housing units or businesses located in an area with a 1% or greater chance of flooding per year. Nearly as many, 72%, reported having a significant number of housing units or businesses located in an area with a .2% or greater chance of flooding per year. Fifty-one percent of the respondents reported having important infrastructure, such as government facilities and hospitals, located in an area with a 0.2% or greater chance of flooding per year.

Twenty-seven percent of the respondents reported having a documented recovery plan that describes how the community would seek to change the use of the property in the flood plain after a future flood event. Thirty-six percent of respondents said that flooding was a "most important" issue for their community to address in the coming year. Over half, 52%, said the flood issue is "somewhat important." Only 12% placed it in the "least important" category.

We asked communities to write-in what issues their community felt to be more important than flood risk control. Economic and budgetary concerns clearly led the responses, with 34 of 86 responses referencing them in some way. Mention was also made of flood recovery, lack of community or public official understanding and appreciation of flood risk, other specific hazards (such as earthquakes, wildfires, tornadoes, volcanoes, hazardous materials and tsunamis), and maintaining core services (such as public safety, water and sewer). One responder commented that bureaucratic difficulties arose from jurisdiction over problematic land being held by a different public entity.

Communities that have a documented flood recovery plan were asked to summarize the contents of the plan. We received 30 responses. Nine mentioned efforts to prevent vulnerable construction in the floodplain or in areas of repeated flooding, including acquisition of flooded properties or limitation of construction in the floodplain. Twelve others mentioned a federally compliant hazard mitigation plan or a local ordinance that controls building in the floodplain. One community mentioned a history of acquiring and relocating properties in the floodplain using private foundation money.

When asked specifically whether their community had attempted to buy private property located in the floodplain for rezoning and redevelopment as a natural area, 25 of the respondents (40% of those answering the question) said their community had made such an effort. The remaining 60% said they had not.

Communities that had experienced a flood in the past five years were asked what the community did after that flood to encourage residents to flood proof their property. We received 57 responses. Seventeen conducted public outreach and education. Ten used buyouts and relocations. Fourteen adopted and/or enforced building codes, zoning, and mitigation requirements. Eight invested in or were considering flood control, such as storm water drainage improvements and barriers.

## Zoomerang Survey Results

# Floodplain Management Survey

Response Status: Completes | Partials

Filter: No filter applied

Feb 03, 2010 1:36 PM PST

**Is flooding an issue for your community? Would you like to have your voice heard by floodplain policy makers? Participate in PERI's floodplain management survey and have your voice heard at the Third Assembly of the Gilbert F. White National Flood Relie**

| **1. Name of public entity or the type of entity and the state in which you are located:** |
|---|
| 108 Responses |

| **2. Your position:** |
|---|
| 108 Responses |

| **3. Does your community have a significant number of housing units or businesses located on land with a 1% chance of flooding each year? (100 year flood zone)** | | | |
|---|---|---|---|
| Yes | | 85 | 79% |
| No | | 23 | 21% |
| **Total** | | 108 | 100% |

| **4. Does your community have a significant number of housing units or businesses located on land with a .2% chance of flooding each year? (500 year flood zone)** | | | |
|---|---|---|---|
| Yes | | 74 | 72% |
| No | | 29 | 28% |
| **Total** | | 103 | 100% |

| 5. Does your community have important infrastructure, such as hospitals or government facilities, located on land with a .2% chance of flooding each year? (500 year flood zone) | | | |
|---|---|---|---|
| Yes | | 54 | 51% |
| No | | 52 | 49% |
| **Total** | | 106 | 100% |

| 6. Does your community have a documented recovery plan for future floods that describes how the community would seek to change the use of property in the floodplain after a flood event? | | | |
|---|---|---|---|
| Yes | | 28 | 27% |
| No | | 77 | 73% |
| **Total** | | 105 | 100% |

| 7. How would you rank flood risk control on the list of issues that are important for your community to address within the coming year? | | | |
|---|---|---|---|
| Most Important | | 38 | 36% |
| Somewhat Important | | 56 | 52% |
| Least Important | | 13 | 12% |
| **Total** | | 107 | 100% |

| 8. What issues facing your community, if any, do you consider to be more important than flood risk control? |
|---|
| 86 Responses |

| 9. Has your community experienced a flood in the past five years? | | | |
|---|---|---|---|
| Yes | | 72 | 66% |
| No | | 37 | 34% |
| **Total** | | 109 | 100% |

| 10. What did your community do after that flood to encourage property owners to flood proof their property? |
|---|
| 57 Responses |

| 11. Did your community attempt to purchase privately held property located in the floodplain for rezoning and redevelopment as a natural area? | | | |
|---|---|---|---|
| Yes | | 25 | 40% |
| No | | 37 | 60% |
| **Total** | | 62 | 100% |

# BUILDING COHERENT RISK ASSESSMENT AND COMMUNICATIONS IN FLIGHT

**Lewis E. Link**
***Department of Civil and Environmental Engineering***
***University of Maryland***

It has often been said that you can not fly a plane while you are building it. While this seemingly represents a truism, it is in fact what we are doing in applying risk to river floodplain and coastal flooding issues. While the risk methodologies are relatively well developed in non-engineering professions such as pharmaceuticals and medicine, they only have been reasonably developed in select infrastructure areas such as nuclear power and large dams. Even there, the emphasis has been focused on safety of rather complex infrastructure entities at relatively confined sites. The broader problem of assessing risk for geographically distributed infrastructure systems associated with floodplains and coastlines is just now emerging.

There have been few comprehensive attempts to configure and apply risk concepts to large geographically distributed infrastructure systems. The recent efforts in New Orleans, California and the Netherlands provide examples of what is possible and the many challenges. The smallest scale of these was the assessment of New Orleans post Hurricane Katrina. The Interagency Performance Evaluation Task Force (IPET) configured a prototype methodology that included an innovative approach to hazard definition, a reasonably consistent and quantitative approach to reliability and a relatively conventional approach to consequences This prototype process was used to estimate the distributed vulnerability to flooding and expected losses (life and property) for the basins within the 350 miles of levees, floodwalls and pumping stations that surround New Orleans and vicinity, an area of approximately 390 square miles. The distinctive outcome of this work was a series of maps showing vulnerability to flooding, loss of life risk and property loss risk for pre-Katrina, post-Katrina (repaired system) and post- construction of the Hurricane Storm Damage Risk Reduction System currently being constructed.

A more general effort was the Louisiana Coastal Protection and Restoration (LaCPR) Study. The LaCPR study endeavored to examine alternative concepts for providing risk reduction for the most extreme storms and beyond that provided by the 100-year system currently under construction. LaCPR used the same hazard (distributed hurricane surge and wave levels) as IPET, but less sophisticated analyses of reliability to allow examination of many alternative approaches to risk reduction to include combinations of structural and non-structural measures (such as marshes) over geographical areas beyond the existing infrastructure footprint evaluated by IPET.

The second application was the Delta Risk Management Strategy (DRMS) funded by the State of California and focused on flood risk for the Sacramento-San Joaquin Delta and the Suisun Marsh of the Central Valley of California. This represents approximately 1350 square miles with over 1300 miles of federal and State levees and many additional miles of locally controlled levees. While hurricane generated surge and waves represented the primary hazard in New Orleans,

floods from high river flows and earthquake induced levee failures represented a multi-hazard for the Central Valley. DRMS developed a systematic approach to estimate the potential for ground motion from a wide variety of potential earthquake scenarios and examined the reliability of the levees under these conditions. Flooding was simulated for different failure scenarios and the extent of flooding estimated. The potential for different levels of consequences (loss of life and economic) was estimated based on the flooding scenario assumptions as well as the indirect losses that would occur from the interruption of the flow of fresh water to Southern California. The outcome of this work was a comprehensive set of statistics to assist the State in decisions on reducing flood risk for this area.

The third effort and the largest in geographical scope is being accomplished by the Dutch. They have examined flood risk for selected polders and are in route to a comprehensive evaluation of their entire country, an area of approximately 16,000 square miles. The Netherlands is a land the majority of which was reclaimed from the sea and today lives with a significant percentage below sea level. It is broken into polders or basins that rely on dikes to reduce the likelihood of flooding from rivers and larger dikes and numerous flood barriers to ward off storms in the North Sea. The government undertook an assessment of the polders to better understand the levels and sources of risk for the future given the persistent challenges of sea level rise, changes in the severity of river flood patterns and potential increases in severity of coastal storms. The Netherlands is moving toward a risk based process to inform future structural and non-structural risk reduction investments.

Each of these efforts has resulted in information of sufficient value to influence important investment decisions. Their products demonstrate the value of understanding the relative vulnerability to flooding of specific areas and the sources of that vulnerability. Coupled with the knowledge of the consequences of flooding, they provide valuable insight to which investments will best reduce risk (and consequences). In New Orleans, risk estimates have been a significant input to the hurricane Storm Damage Risk Reduction System design and investment priorities. In California, the DRMS has provided a systematic look at the size and nature of the problem faced in the Central Valley and is helping to shape both policy and investments for the future. The Dutch assessments have become a significant input to the new Delta Model initiative and the strategy of significantly increasing the reliability of river and coastal defenses over the next two decades.

These efforts have also pointed out the large uncertainties that characterize the processes involved and the resulting products of such analyses. Defining the hazard is particularly challenging given the complexity of phenomena such as hurricanes, runoff and earth quakes. But, so too is the quantification of the reliability of structures under a wide range of forces. Changing demographics, typically resulting in more people living in areas adjacent to water, has complicated the estimation of expected losses, adding additional uncertainty. In addition, in all cases a major challenge has been the ability to communicate the meaning and the value of risk information to both decision makers and the public.

It is important that we recognize that risk assessment for distributed water resources infrastructure is in its infancy. The movement to this type of analysis and decision support is a paradigm shift from the legacy approach of principally considering the hazard and consequences separately. In each application to date, prototype methods have been configured by exploiting

available knowledge and analysis tools. Results have been meaningful, but also point to the need for refinement and sophistication. Contrasting these efforts also points out the need for assessment methods that fit the needs of different types of projects or studies, from general regional planning to informing design. As a water community we need to approach this new area with considerable thought, deliberate experimentation, and full collaboration. Pilot projects would be very useful to test drive new methods, to understand levels and sources of uncertainty in assessment components and judging the limits of the information generated. Perhaps the most generic of all needs is the ability to communicate the meaning and relevance of results, a task normally set aside by the analysts of our profession. Communication should be an essential component of any experiment or pilot effort.

# BUYING DOWN FLOOD RISKS THROUGH INTEGRATED FLOOD MANAGEMENT

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***California Department of Water Resources***

**Introduction**

Since the establishment in 1911 of the State Reclamation Board, the State of California has been in the business of building, maintaining, and implementing flood damage reduction projects and programs in the flood prone Sacramento and San Joaquin Valleys and throughout the State. In 2006, California voters approved Propositions 84 and 1E, which provide approximately $4.9 billion in bond funds to improve flood infrastructure and flood risk reduction programs in the Central Valley and other parts of the State. In 2007, the Legislature passed, and the Governor signed, a package of seven flood bills that together bring definition to an overall strategy to implement the Proposition 84 and Proposition 1E bond funds and improve existing flood risk reduction programs in DWR. The new bond funds and the seven flood bills prompted the Department of Water Resources to develop the California FloodSAFE initiative, http://water.ca.gov/floodsafe/. This paper describes projects and programs that DWR is implementing to buy down flood risk through nonstructural methods that are part of an overall strategy to implement and encourage "Integrated Flood Management" throughout California.

**Building Codes for 200-year Floodplains**

Responding to Health and Safety Code Section 50465 (required by Senate Bill 5, 2007), the California Department of Water Resources (DWR) developed and proposed for adoption and approval by the California Building Standards Commission (CBSC) updated requirements to the California Building Standards Code (Code). The updated requirements apply to single-family homes and residential care facilities with six or fewer clients in areas protected by the facilities of the Central Valley Flood Protection Plan (CVFPP) where flood depths are anticipated to exceed three feet for a 200-year flood event. The proposed codes focus on improving public safety under deep flooding conditions by mitigating the two key flood threats of entrapment and/or drowning and serious injury or death caused by flood-induced structural failure.

The Code updates address flood threats by providing a route to an evacuation location where occupants would be above the 200-year flood water surface elevation and can be evacuated by a rescue vehicle. Also, portions of buildings and structures that support evacuation locations shall be designed, constructed, connected and anchored to resist flotation, collapse or permanent lateral movement due to unbalanced hydrostatic pressures. Code provisions allow building owner/ designer, along with local governing authorities, design flexibility and a wide range of options to comply with Code.

DWR submitted its initial recommendation package to the CBSC in July 2009. The revised recommendation California Building Standards Code Update package was available for public review and comment through December 16, 2009 and was unanimously approved for the voluntary appendices of the Code by the CBSC on January 12, 2010. The effective date of these

building standards will be March 1, 2012 or ninety days after the corresponding maps from the approved CVFPP are completed and readily available to the general public, whichever is the later date.

Subsequent to the initial phase, DWR plans to expand flood provisions within the Code to further address additional building types such as educational, institutional and additional residential occupancy groups, as well as additional measures – e.g., ensuring emergency facilities remain operational during floods – to ensure public safety and achieve flood damage reduction to buildings and related property. For more information on this project, please visit http://www.water.ca.gov/BuildingCode .

**Best Available Maps on the Web**

Senate Bill 5 (SB 5), which was enacted in 2007, authorized DWR to make available by July 1, 2008 100- and 200-year floodplain maps located within the Sacramento-San Joaquin (Sac-SJ) Valley watershed, which includes 32 of California's 58 counties. SB 5 requires that these preliminary maps be provided as best available information on flood risk to cities and counties in the Sac-SJ Valley watershed. Pursuant to the legislation, DWR collected the 100- and 200-year floodplain maps for the 32 counties and 91 cities located within the Sac-SJ Valley watershed in July 2008 and organized them into a GIS system. These maps were compiled based on the best information available from several sources including: FEMA 100-year preliminary and effective DFIRM data and updated Q3 flood data; DWR 100-year floodplain awareness maps; United States Army Corps of Engineers' 100- and 200-year floodplains developed for the 2002 Sacramento-San Joaquin River Basins Comprehensive Study; and Floodplain maps developed by local agencies.

In addition to the legislative requirement, DWR has initiated development of a similar set of best available maps for the 100- and 200-year floodplains located outside the Sac-SJ Valley watershed. There are a total of 40 counties completely and partially outside the Sac-SJ Valley boundary and 381 cities outside the Valley boundary. Currently, DWR is in the process of collecting floodplain maps developed by the USACE Los Angeles, Sacramento, and San Francisco District Offices to incorporate into the data sets for the best available maps for the areas outside of the Sac-SJ Valley watershed.

The counties and cities can use these non regulatory maps for planning purposes including development and update of the land use element, conservation element, housing element, and safety element of city and county general plans. The maps can also be used for the FEMA required community Multi-Hazard Plans (DMA2000) and for community emergency response plans. For more information on this project e visit http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/best_available_maps/ .

**Flood Risk Notification to Property Owners and Residents**

As required under Water Codes § 9121 and 9130 (Assembly Bill 156), DWR is developing and implementing a Flood Risk Notification Program for properties protected by facilities the State Plan of Flood Control (approximately 1,600 miles of State/Federal levees and other facilities). These activities include the development of Levee Flood Protection Zone maps, the acquisition of parcel data—GIS shape files and the associated attribute data (assessor parcel number, addresses, owner names, lot size, land use, building square footage, etc.)—and written notices of potential flood risk to property owners and current residents in the Levee Flood Protection

Zones. The parcel data is needed to develop mailing lists of property owners who have properties protected by project levees, and the notifications will be sent out by September 1, 2010, and annually thereafter.

A draft Flood Risk Notification flyer has already been prepared and finalized. One of DWR's key activities as the flyer nears completion will be to meet with cities, counties, and regional flood agencies to share the draft flyer with them, informing them about the notification that will be sent to their communities. Currently, the total number of parcels in the LFPZs is estimated to be approximately 370,000. DWR is utilizing current research on natural hazards communication to develop the risk notification flyer, website, and related products. The LFPZ maps can be found at http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/levee_protection_zones.cfm .

**Alluvial Fan Task Force**

Assembly Bill 2141 recommended the creation of the Alluvial Fan Task Force (Task Force), which DWR's Director convened in February of 2007. Task Force members included elected officials from the ten Southern California counties in the study area, representatives of the development and environmental community, local floodplain managers and associated state and federal agencies, including FEMA, plus at-large members representing other issues related to future development on alluvial fans.

The study area of the Task Force included the ten Southern California counties of Los Angeles, Kern, San Bernardino, Riverside, Orange, San Diego, Imperial, Ventura, Santa Barbara and San Luis Obispo as defined in Assembly Bill 2141. Development on alluvial fans has increased dramatically over the years because alluvial fans are generally regarded as attractive home sites, given their gentle slopes and panoramic views. With increasing housing development pressure, there is a critical need to provide guidance on how to accommodate growth while still protecting the beneficial values of alluvial fan floodplains and life and property from flood hazards.

The Task Force developed a suite of local planning tools (Integrated Approach Toolkit) for pre-project screening that are designed to assist local communities that need to plan for and evaluate future development proposals on alluvial fans. Flood management tools were also developed by the Task Force, consistent with FEMA guidelines, to analyze alluvial fan flood hazards and to formulate flood hazard protection. Together, these tools suggest how to incorporate multiple objectives into future development on alluvial fans to ensure public health and safety, reduce the losses and damages caused by the natural hazards that may be present on alluvial fans, and preserve the beneficial values provided by alluvial fans. The Task Force was also charged with developing a Model Ordinance pursuant to Assembly Bill 2141 that cities and counties with alluvial fans located within their jurisdictions may voluntarily adopt or modify as needed to meet local needs.

After reviewing the history of alluvial fan flooding in Southern California, the lessons learned from development in these areas, and the nature and physical characteristics of alluvial fan flood hazards, the Task Force has developed specific recommendations for future action by the State and other public agencies (Findings and Recommendations Report). For more information on this project, visit http://aftf.csusb.edu/ .

**California Levee Database**

California has in excess of 13,000 miles of levees that protect residential and agricultural lands. The levee failure during the event of hurricane Katrina prompted DWR to initiate development of a state-of-the-art levee database for the purpose of identifying and improving the management of levees throughout the State. The California Levee Database (CLD) will support an efficient and effective methodology for assessing levee reliability risk assessment factors and structural data for individual levee reaches. Starting in 2005, partnering with FEMA as part of the Map Modernization Management Support (MMMS) program, DWR has initiated the assembly of critically needed levee information identifying relevant data about ownership, location, and risk assessment factors for levees in California. Recognizing that other agencies are undertaking similar efforts, DWR is participating in national and regional work groups organized by FEMA and the USACE to help ensure compatibility and coordination with other national efforts including the development of the USACE of the National Levee Database. As of the current fiscal year, the FEMA MMMS program and DWR have invested approximately $2.75 million in the CLD.

Since 2005, DWR and FEMA have developed a GIS database for approximately 13,000 miles of levees and flood control structures within the State of California. Major accomplishments for the CLD include:

- capture of geographic levee features for 58 counties in the State;
- met or contacted 147 agencies and jurisdictions;
- review and identification of 13,737 miles of levees and flood control structures;
- review of approximately 2,770 USGS quad maps;
- geo-referencing and review of 861 FIRM panels;
- capture of existing stream stations from USGS quads for major tributaries;
- capture of attribute data for bank location and flooding source for 98% of all levees;
- capture of attribute data for maintenance and authorities for approximately 50% of levees;
- capture of attribute data for project levee for appropriate levees;
- coordination with USACE and FEMA on integration of levee database with other efforts;
- review of 4,000 technical resource documents and retrieval and linkage of relevant information to levees;
- addition of boreholes, levee distress points, flood-fight points, and inspection points;,
- incorporation of GPS survey location data from the USACE National Levee Database and LiDAR data collected of 350 miles of urban levees;
- development of data sharing and exchange protocols with database from USACE and FEMA; and
- development of web-based dataset viewers to simplify access to GIS datasets.

**Emergency Response Plans**

DWR is developing model flood emergency response plans for communities exposed to potential coastal, riverine, and alluvial fan flood threats. Three communities have been selected for study in order to tailor the model emergency response plans to actual community based applications. The model plans will include comprehensive flood hazard identification, flood preparedness, flood response, and recovery strategies and actions. The model plans will include templates, tools, and identification of needs for technical assistance. Once the ERPs are complete, the developed information and strategies can be incorporated into the community FEMA required multi-hazard plan and NFIP/CRS floodplain management plan.

**Community Rating System Uniform Minimum Credit Points**

DWR is implementing a strategic plan for the voluntary NFIP Community Rating System (CRS) program, in coordination with FEMA. Information on existing State programs and activities is being collected and analyzed to determine the potential for increasing CRS Uniform Minimum Credit (UMC) points on a statewide and regional basis. Increasing UMC points will help participating California communities improve their CRS classifications and thereby help reduce flood insurance premiums for residents located in Special Flood Hazard Areas (100-year floodplain) beyond the current annual savings of approximately $10 million for current community CRS participation. As an example of DWR intent to increase UMC CRS points, the Flood Risk Notification Program described in this paper, may increase existing UMC points by almost 50%. Additional CRS UMC credits are targeted for State sponsored and fiscally supported levee evaluations, levee repairs, and levee improvement projects.

The State will be promoting the CRS program to help increase the number of participating communities, and the level of participation by existing CRS communities. The development of a California-specific handout on the benefits of joining the CRS is being planned, as is a "Quick App". The "Quick App" will show automatic (UMC) or likely credits for most California communities. Communities that are not currently in the program but have expanded Special Flood Hazard Areas due to recent DFIRM mapping will be targeted. Other planned activities include the development of model documents to help participants increase their CRS credits, expanding and updating the existing State CRS web page, http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fas/nfip/crs/ , working with other State agencies that can support local programs that receive CRS credit, and encouraging the establishment of regional CRS user groups where communities can support each other to increase their CRS credits.

**Increase number of properties covered by NFIP Flood Insurance**

In August 2007, DWR completed a draft report titled "Alternatives for Increasing Flood Insurance Participation for Communities Protected by levees." DWR conducted analyses that concluded that rural and urban communities in levee protected areas in the Sacramento and San Joaquin Valleys had very low property owner participation in the National Flood Insurance Program. Very few Central Valley properties owners purchase flood insurance on a voluntary basis. This report explores alternatives for increasing property owner purchase of flood insurance through the NFIP.

**Handbook for Implementing 2007 Flood Legislation**

DWR is in the final stages of completing a guide for implementing the 2007 California flood management legislation. The report titled, "Implementing California Flood legislation into Local Land Use Planning: a Handbook for Local Communities" provides a comprehensive guide to the changes in the Government Code, Water Code, and Health and Safety Code that affect the preparation of general plans, general plan updates, local hazard mitigation plans, development agreements, zoning ordinances, discretionary permits, levee flood protection zones, flood emergency plans, relocation assistance, funding mechanisms, flood management report of information, and safety plans.

# RISK IS A FOUR LETTER WORD

**Dale Lehman**
***URS Corporation***

There are many topics in floodplain management that spark heated discussions and debates. Topics such as the pros and cons of structural flood mitigation often lead to energetic discussion, but few topics create more divergent and polarizing opinions than flood risk.

The definition of risk is "hazard: a source of danger; a possibility of incurring loss or misfortune." We can also look at the following related definitions:

- Risk Management – "the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events"
- Risk Assessment – "Risk assessment is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognized threat (also called hazard)"
- Risk Analysis – "A systematic use of available information to determine how often specified evens may occur and the magnitude of their consequences"

Now if we look further, we can find flood risk assessment definitions such as:

- "A flood risk assessment is an assessment of the risk of flooding, particularly in relation to residential, commercial and industrial land use"
- "An assessment of the likelihood of flooding in a particular area so that development needs and mitigation measures can be carefully considered"
- "A detailed assessment that examines site-specific flooding issues"

The problem lies in the definitions and lack of clarity. Additionally, fully understanding risk requires detailed understanding of probability and economics. None of these are easy to understand and getting consensus on quantification of risk among diverse stakeholder groups can be a daunting endeavor.

Flood risk, as seen from the uniquely different definitions above, is further complicated by the inherent uncertainty of the underlying hazard data that serves as the foundation for quantifying flood risk. We have been assessing and publishing flood hazard data for decades and yet it is still a difficult task to have public officials and the public at large understand the complexities of hydrology, hydraulics, and probabilities associated with flood analyses.

At the Symposiums 1 and 2 for this Forum, these divergent opinions regarding what flood risk is, how to quantify the risk, and how to communicate the risk was evident. The challenges faced by getting this understanding at a national level was demonstrated by the fact that some of the most knowledgeable floodplain management professionals in the nation could not agree if a uniform method for quantifying risk is needed. I contend that different methods for different situations are warranted for different technical objectives. However, we need a uniform method for

presenting risk to the public so that they can understand the risk, and that they will support and embrace policies and programs for risk reduction that are enacted by agencies and elected officials at all levels of government.

It would be easy to give up and say the task is too hard and complicated to complete. However, there are models and precedents that point the way and that the task can be accomplished.

I was impressed by the programs and initiatives that Colin Thorne presented at the 2007 Gilbert White Forum. These programs being implemented in the United Kingdom (UK) are making a difference and have support by elected officials and the public because they understand flood risk and make decisions based on their understanding of the risk. They understand that they cannot sustain their standard of living and quality of life if they continue development and land use decisions without considering the risk.

In 2001, the UK Department for Communities and Local Government published Planning Policy Statement 25 for Strategic Flood Risk Assessment. This policy was revised in 2006 and has been adopted by England and Wales.

The policy addresses development and flood risk. It requires that flood risk is taken into account at all stages in the planning process to eliminate inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where there are absolutely no options for placing new development in areas of high flood risk, the policy provides for exceptions, but only if specific actions are taken to make the development safe, provide for no adverse flood risk elsewhere, and, where possible, reducing flood risk overall.

The document provides guides for quantifying risk, considering future conditions including sea level rise, and emphasizes addressing residual flood risk that exists behind structural flood mitigation measures. The approach was developed with a blend of technical and sociological factors and techniques. I believe this blend has been central to the success that they have achieved in communicating the risk to the public and elected officials.

We can achieve the same vision and successes in the United States. It will require compromise and weaving best practices from a variety of sources. Failure to complete this task will yield ever increasing flood damage and consequences. It has been nearly five years since Hurricane Katrina devastated the Gulf Coast. The country is still paying for the economic consequences of that one disaster and the economic impacts are felt nationwide.

Risk is a four letter word, but so is Hope.

# AN INTEGRATED APPROACH TO MANAGING FLOOD RISK FROM DAMS THROUGH EMERGENCY PREPAREDNESS AND RESPONSE

**Mark B. Ogden**
***Association of State Dam Safety Officials***

Dams provide valuable resources to society, yet they could pose a significant risk to downstream residents and property. While the risk of dam failure is generally low when compared to other flood risks, the consequences of a failure can be catastrophic. Dam safety officials must work with dam owners/operators, and with local emergency management and floodplain officials to manage this risk.

The primary function of the dam safety official to manage the flood risk from dams is in the technical realm of engineering design and inspection to help ensure that dams are properly constructed, operated and maintained and that they do not fail. The dam safety official also participates in the greater element of emergency preparedness and planning. This acknowledges that even a well designed and maintained dam still presents a flood risk and preparation for emergency situations must be considered. The Association of State Dam Safety Officials (ASDSO) has been working to define the roles for key stakeholders in dam safety and to facilitate an integrated approach to ensure the most effective use of resources in managing flood risk.

**Dam Safety Flood Risk Management Roles**

Dam Owner Roles – The most important stakeholder in managing the flood risk from dams is the dam owner. The dam owner must be the expert on the operation and maintenance of the dam and work cooperatively with local officials and dam safety regulatory officials in emergency preparation and response. The dam owner is responsible for the following:

- Construction, operation and maintenance of the dam in accordance with acceptable safety standards.
- Development and maintenance of an emergency procedure (Emergency Action Plan (EAP)) to help mitigate flooding impacts should a failure occur.
- Providing the EAP to local officials as a tool for identifying the potential hazard that the dam may pose to the downstream area.
- Education of local officials about the specifics of the operation of the dam.
- Working with local officials to help educate the public about dam safety flood risks.
- Management of emergency situations with the dam including the activation of the EAP.

Local Official Roles – These are State and local emergency management and floodplain management officials involved with planning for and management of emergency response situations. These officials are the experts in emergency planning and response and they must be the lead in those situations. Local officials must:

- Work with dam owners and dam safety officials to understand the dam safety risks in their jurisdiction and incorporate dam safety hazards into local comprehensive hazards plans.

- Work with dam owners, local emergency responders, and dam safety officials to ensure that EAP's are exercised and up to date.
- Educate the public on all risks including risks from dams. The methods for accomplishing this will likely vary depending on the number of people and infrastructure at risk in a jurisdiction and the goals of the local emergency plan.
- Manage emergency situations involving dams.

Dam Safety Official Roles – These are State, federal and local officials involved with the regulation of dam safety. These officials are experts in dam safety standards and practice and they must share that expertise with the dam owner and with local officials in emergency planning and response. State dam safety officials must:

- Enforce the safety standards for design, operation and maintenance of a dam and participate in the development and maintenance of an EAP.
- Review and approve the dam safety technical aspects of the EAP including failure inundation mapping and failure mitigation methods as appropriate.
- Educate dam owners and local officials about the probability of dam failures and failure modes. Educate the public indirectly through local officials and emergency managers and as part of the overall "message" of flood risk reduction.
- Facilitate emergency preparedness between dam owners, emergency managers and local officials.
- Assist dam owners and local officials in managing dam safety emergency situations by providing technical expertise relative to the dam failures and incidents.

Dam safety regulatory programs and local emergency management and floodplain management officials have limited resources and it is imperative that those resources are used in the most effective and efficient manner possible. The state dam safety regulatory community has been working through ASDSO to facilitate an integrated approach to dam safety flood risk management. This includes developing relationships with emergency management and floodplain management associations to identify ways to help all dam safety stakeholders to achieve the common goal of public safety and flood risk reduction. It is important that the primary responsibility of the dam safety official is to prevent dam failure, but it is also important that they participate appropriately in managing the consequences of potential dam failures.

# WITHIN THE WATERSHED: FLOOD RISK, FLOODPLAIN RESOURCES AND RESPONSIBILITY

**Laura Tessieri**
***Delaware River Basin Commission***

Watersheds are natural divisions of land defined by hydrology and geomorphology. They do not adhere neatly to our political, jurisdictional boundaries. One benefit of the watershed is that it can be a mechanism by which dialogue between differing divisions of government can take place. Unified interests can bring parties to the table; including environmental, recreational and cultural resources. Recognition and prioritization of these values help define the resource. Issues that cause division are likely when these valued resources are at risk. During times of short water supply, ecosystem or water quality concerns and catastrophic flood events; strained economic concerns can lead either towards inaction and stalemate or be the impetus to encourage sustainable watershed management that can result in reduced risk. An effective evaluation of risk must include a true valuation of resources.

**Governance and Professional Realities**

The goal of watershed management is to plan and work toward an environmentally and economically healthy watershed that benefits all who have a stake in it. Within a watershed, floodplain management decisions occur in venues ranging from neighborhood groups serving a few dozen people to the federal government. It fact, even the individual or family that decides to reside in a flood risk area is an integral part in the equation of those that make floodplain management decisions. Effective flood risk reduction takes recognition of the risk, prioritization and then action on the part of many.

A major motivation on all levels of scale is economics. In order to better secure the economic soundness of a family/individual home investment, a sustainable and viable economy at the local government level and the economic well-being of the Nation, flood risk must be elevated to the forefront of informing land use decisions. The short-term economic gain of development in a flood risk area is not an economically viable or sustainable solution. It must no longer be seen as acceptable to allow these risky development decisions. Developers, individuals and land use authorities who chose to build in flood risk areas must not only begin to recognize the ultimate cost of their development but be held responsible.

How then, can we effectively elevate flood risk so that it is not only considered, but is at the forefront of land use decisions? Important steps include:

- Availability of tools and resources that communicate of flood risk
- Valuation of flood risk and floodplain resources
- Create new expectations of acceptable and appropriate use in floodplains
- Foster consistent or equitable use of floodplains throughout the watershed

**Availability of Tools and Resources**
Today's world is built around the digital environment with online technical information expected by both professionals and the individual. With floodplain management decisions being made on many fronts, readily available digital tools and resources are integral in informing sound planning and land use decisions.

One such tool are Digital Flood Insurance Rate Maps (FIRMs) which include the option to view risk areas on aerial mapping or in conjunction with planning tools such as ArcGIS. As not all users have the technical programs or capability to use these tools, a Google Earth download or similar technology could be a very effective means of visibly communicating areas of flood risk to individuals and local governments. Flood maps provide the unintended message of little or no risk beyond defined risk areas, As such, other tools include storm surge modeling in coastal areas or flood inundation mapping made available online through the National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) page. This mapping translates the potential impact of flood stage to the surface of the ground.

Availability of flood risk information is not enough to alone spur effective action. But, it is an essential and integral part of creating a culture that recognizes and values sound floodplain management.

**Valuation of Flood Risk and Floodplain Resources**
Providing reliable data is only part of the process. Risk is a social construction, and perception is the core issue. Risk has two dimensions: 1) what is known about the hazard itself, and 2) what is felt about it. There is a tendency for the public to pay too much attention to the latter dimension, and for experts to pay too little attention to it (Morrow, 2009).

The definition of risk, *Risk = Hazard x Exposure x Probability*, (National Research Council 1989) implies that if decision-makers are provided with adequate information about the hazard, correct information on their level of exposure, and estimations of the probability of being impacted at that location, they can make reasonable estimations of risk and make sound decisions. It has been suggested that *Probability + Values = Real Risk* (Tinker and Galloway 2008). This equation takes into account the human perspective. Facts regarding flood risk are critical, but equally important is what people value (including safety, experience and economic interests)

In informing risk, the time is right to reinforce and value economic interests in making floodplain management decisions. The equation must be expanded beyond short-term economic gain to an expectation by all for both the government and individual to plan for long-term economic viability and sustainability. To accurately inform and evaluate economic interests, more studies that quantify the true value and intrinsic benefits of the natural floodplain are needed.

**New Expectations of Acceptable and Appropriate Use**
The White House Council on Environmental Quality (CEQ) released a proposal to the National Academy of Sciences (NAS) in December 2009 that would significantly change the principles and guidelines that govern America's water resource planning. The proposal would require that such projects help to improve the economic well-being of the Nation for present and future

generations, better protect communities from the effects of floods and storms, help communities and individuals make better choices about where to build based on an understanding of the risk, and protect and restore the environment (White House CEQ, 2009).

*Unwise Use* is defined by the CEQ as any action or change that is incompatible with or adversely impacts one or more resources to the extent that it or they are no longer self-sustainable. For floodplains this includes floodplain functions. As mentioned, floodplain management decisions occur on many levels. This CEQ proposal is a step towards encouraging the wise use of our nation's floodplains.

**Foster Consistent and Equitable Use of Floodplains**

The Delaware River Basin Interstate Flood Mitigation Task Force, convened at the request the governors of the four basin states – Delaware, New Jersey, New York and Pennsylvania, identified six priority management areas and a total of 45 consensus recommendations for a more proactive, sustainable, and systematic approach to flood damage reduction in the basin (Interstate Task Force, 2007). One of the priority management areas was Floodplain Regulations.

The Flood Advisory Committee of the DRBC found that regulations currently in place for addressing development in the floodplain have not successfully reduced flood damages; in fact regulations throughout the watershed have allowed new development and redevelopment to continue with the result being a continued increase in flood damages.

The Committee also found that regulations vary greatly from state to state throughout the watershed. As one example, at points along the Delaware River, current regulations in New Jersey require new construction to be built approximately 6' above the FEMA base flood elevation (1' above the NJ Flood Hazard Area Design Flood), whereas at the same location across the river in Pennsylvania, the lowest floor of new construction is permitted to be built at the FEMA base flood elevation. (Flood Advisory Committee, 2009).

The Flood Advisory Committee proposed that consistent floodplain regulations need to be applied on a broader, watershed basis and not adhere to state jurisdictional boundaries to be effective. Key recommendations of the Committee include:

- The regulatory floodplain should be greater than the 1% annual chance floodplain;
- The floodway in the Delaware River Basin should be defined by a 0.2 foot rise standard;
- New development in floodways should be prohibited;
- The flood fringe should be protected, allowing only passive uses;
- Development in the flood fringe should be limited to the maximum extent possible;
- Require critical facilities to be kept outside of the 0.2% annual chance floodplain to protect life, health and the local economy;
- A vegetated, riparian buffer should be established, either 100' or a variable-design;
- All new or substantially improved structures be constructed with two (2) feet of freeboard,
- Deed restriction should be required for enclosures below the flood hazard elevation; and
- Stormwater design should mimic pre-development hydrology at a minimum.

**Responsibility**

The responsibility of flood loss reduction is one that is largely perceived as belonging to the federal government. It is time for this responsibility to be expected of and shared with the States, regional entities, local government and the individual.

State responsibility should not be ignored. States need to foster sound floodplain management decisions and require that its communities both understand flood risk and make wise decisions regarding the use of its floodplains. The policies and practices that reward risky land use decisions and promote unwise use of the floodplains are not sustainable and should no longer be accepted.

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# FOLLOWING THE LEAD OF GILBERT WHITE IN FLOOD MANAGEMENT APPROACHES

## Kyle E. Schilling

This Forum continues the impressive legacy of Gilbert F. White. His thoughtful1942 dissertation followed the century or so of efforts leading to the 1936 Flood Control Act, which set out the protocols for Federal and non-Federal responsibilities for major flood control works, including non-Federal cost sharing. His basic logic (Schad, The Flood Control Challenge: Past, Present, and Future, 1988, Public Works Historical Society) and framework for categorizing actions remains valid today. He started with the premise that "floods may be acts of God; but flood losses are inevitably the results of acts of man." Thus the problem becomes one of adjusting the human habitat in the flood plain with effective resources management. He had four essential points:

First, the spectrum of possible adjustments;

- elevation of occupied portions of the flood plain above maximum flood levels,
- reducing floods by various land use techniques,
- structural protection,
- emergency actions such as the removal of people and goods,
- structural adjustments such as flood proofing buildings, etc.,
- land use controls,
- public relief,
- insurance.

Second, consistent benefit/cost evaluation of alternatives including community welfare and non-monetary;

Third, recognize that certain types of occupancy is necessary and that periodic flooding benefits certain agricultural uses; and

Fourth, actions taken in responding to flood plain occupancy should promote effective flood plain use.

The National Water Commissions Report of 1973 reflected on individual improvements across the spectrum of White's adjustments. While the National Council on Public Works Improvement (Fragile Foundations 1988) called for improved intergovernmental coordination and in addition explicitly cited the need for Federal/state levee safety, risk based analysis, and rationalizing stormwater management and major flood control practices. The Interagency Flood Management Review Committee in its 1994 report "Sharing the Challenge" recommended improved means for shared responsibility and accountability using the full structural and non-structural spectrum of tools. Additionally; in its 1994 report "Higher Ground" examining voluntary property buyouts and repetitive losses under the National Flood Insurance Program, the National Wildlife Federation found that claims for repetitive losses exceed building values for a substantial

percentage of insured buildings. American Society of Civil Engineers activities and presentations have noted in regard to the New Orleans levee failure that it was a "system" in name only.

In this atmosphere, the ASCE recently published its pamphlet "So You Live Behind a Levee," which concentrates on informing individuals how to recognize their individual flood risk and respond to it.

So; in the face of nearly seven decades of experience since Gilbert White's seminal dissertation the nation still faces a systemic flood issue of two proportions:

- Institutional; to rationalize and evaluate on a comparable basis, actions both structural and non-structural, across the spectrum of possible adjustments in view of his four essential points.
- Structural; to match various components built and managed by different entities over time to some common level of protection and to adjust for changing conditions to a common and well understood level along with complementing emergency relief and insurance actions.

This Forum can serve as an effective force to advance thinking and work on the major systemic issues that remain in the nation's floodplains.

# WATER—EARTH'S LIFEBLOOD

**Karin M. Jacoby**
***National Waterways Conference***

What is water but the lifeblood of our planet; just as blood flows through the human body supporting life, waterways carry across the earth's surface our most essential resource. This simple concept, for too long disregarded, is now becoming widely recognized. Along with this acknowledgement, the realization should come that our current practices for managing water systems have not always served us well, and they are not fully capable of meeting future needs. Much like blood-letting, and many other abandoned medical techniques from past centuries, the water resource management practices presently in use, our current water ways, are quite simply, outdated.

Current water resource policies and programs are implemented and managed piece meal rather than holistically, often producing unintended consequences. While generating economic development, they also result in tremendous financial burdens; while providing for public safety, they also contribute to major disasters; and while serving the needs of many, they also harm the environment. Many waterways throughout the nation still do not meet the "fishable and swimmable" standard, there are water shortages in several regions, damaging floods are being experienced along rivers and coastlines, ecosystems are in decline and habitat is being lost. These are but a sampling of the symptoms that will present should the current practices continue.

In the late 1800's Andrew Taylor Still, MD, DO, believed the conventional medical system did not meet patient needs and that a more holistic approach should be used. In spite of stiff opposition from the medical profession he sought to reform 19th century medical practices. Still was successful in ushering in a new brand of medicine, and he did this by employing his new techniques in the treatment of his patients and achieving positive results. As Still worked to advance his reform movement he had at least one notable advocate, Mark Twain.[1] We are likely to all be familiar with the famous quote widely attributed to Twain, "Whiskey is for drinking, water is for fighting over." Underscoring the value of water, it does nothing to help cure our ailing waterways. What may help is to understand that as an early supporter of this new way of practicing medicine, Twain appreciated its benefits and spoke openly against the medical establishment's resistance to change. He recognized the challenge to achieving success was overcoming the objections of those with an interest in continuing with things as they were.[2]

You may have already guessed why I have chosen this analogy; in a small way it is because, like me, Still and Twain were both from the Show-Me State of Missouri. However, the main reason is because, much like Still's holistic approach to medicine was the founding principle behind his reform movement, I strongly believe the reform of our current water resource management practices should also be founded in a holistic approach. This ideal is captured in the concept of integrated water management. From where rain falls until its capture and consumption, when it sheet flows across surfaces and travels within waterways, and how it is used, cleaned and then re-used, are all considered. There are three critical components that work together in the holistic approach to integrated water management: where is the water, when will it be there, and for what will it be used.

In keeping with the path to success taken by Still, the next step to ushering in this new brand of water management is through the practice of it. There are already utilities and municipalities seeking out and employing techniques developed to achieve integration of their water management systems, but there has been less progress than desirable made on a larger scale. Consider how far water travels, often for many miles, crossing jurisdictional boundaries, those of cities, counties, states, and even nations. Sometimes its arrival is welcome and fresh water supplies are replenished, but other times it is feared as rivers and streams overflow with floodwaters. Through its travels there are many competing uses: water supply, power generation, flood damage reduction, fish and wildlife ecosystems, navigation, recreation, and more. Effective management of our nation's water throughout this century is dependent on integrated water management being practiced on a more impactful scale.

Federal policy may help to guide the effort, but the effectiveness of integrated water management requires states to be more involved. The traditional pattern of federal-state cooperation in this area is mostly comprised of standards being established by federal policy and funding then being used to incentivize state cooperation[3]. Subsequent federal actions that are often punitive in nature are not supportive of planning efforts that could have avoided adverse impacts entirely.[4] More can and should be done at the federal level to support integrated water management planning. Most importantly, states must begin to use their planning jurisdiction to develop integrated water plans. These plans should be prepared using regional approaches respective of population centers and public safety, clusters of economic activity, protection and restoration of ecosystems, and land use.

For too long too many states have taken a passive approach to managing their water resources, and few have engaged in the collaboration necessary to develop watershed based plans that comprehensively provide for public safety together with economic and environmental well-being. States need to step forward and begin collaborating with one another to develop comprehensive plans for integrated water management. The federal support and incentives needed to spur this action within the states should be provided, including funding state planning efforts, hosting collaborative forums, providing research grants for science that can better inform decision making, and more.

Although there is evidence of support for reforming the current system of water resource management practices, there remains enormous energy behind maintaining the status quo. This is to be expected; since with all change there is the anticipation of possibility, accompanied by anxiousness for the unknown. With the ever increasing demands on water coming from many directions, complicated by drought conditions in many regions, disastrous flooding in others, and the rising costs to manage an aging infrastructure, this needs to be the moment of change. Now is the time for the equivalent of blood-letting to stop, and new practices of water management to be brought forth. States should be developing comprehensive integrated water plans, engaging with stakeholders to address needs and allay fears. States should be cooperating with each other to coordinate their comprehensive plans and combine them into regional integrated water plans. States can be the practitioners that develop the cure for our waterways, and stakeholders will then be notable advocates for reforming our water ways.

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# MOVING FLOOD INSURANCE TO THE PASSENGER'S SEAT ON THE HIGHWAY TO FLOOD RISK REDUCTION

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**Introduction**

Since Congress passed the National Flood Insurance Act in 1968 and the National Flood Insurance Program (NFIP) was subsequently created, flood insurance has been in the driver's seat of all existing floodplain and risk management programs. The NFIP was created based on the premise that 1) a program of flood insurance can promote the public interest by providing appropriate protection against the perils of flood losses and encouraging sound land use by minimizing exposure of property to flood losses, and 2) the objectives of a flood insurance program should be integrally related to a unified, national program for floodplain management.

Many federal programs and initiatives have spawned from the National Flood Insurance Act. In addition to offering flood insurance coverage in participating communities, the core components formed from the NFIP include *floodplain mapping* and *floodplain management*. A few examples of NFIP initiatives developed in support of providing flood insurance include:

- floodplain identification and mapping
- floodplain management ordinances that communities must adopt and enforce
- all-hazards planning
- mitigation and disaster assistance grant programs
- the Community Rating System.

These initiatives have had positive impacts on flood risk management. They have allowed us to "build the car, get into the car, and drive the car" toward a more sustainable future. Over the past 40 years, NFIP programs have increased awareness of flood hazards and recognized the natural and beneficial functions that floodplains provide. Flood insurance has driven the car this far, but to travel to the next level of comprehensive risk and floodplain resource management, we must examine whether flood insurance should continue to dictate our path forward.

**Examining the Paradigm**

A paradigm is commonly known as the lens through which something is viewed. This lens tends to provide the fundamental core principles upon which problems are solved, new initiatives are created, and is the basis upon which most subsequent changes or decisions are made. The paradigm that helped create many floodplain management programs was the need to provide a self-sustaining flood insurance program. Floodplain maps identify the likelihood and extent of existing flooding for a 1% annual chance flood and are used to rate flood policies. Maps are also used to regulate new development to minimize exposure to new flood insurance claims. Mitigation grant programs are intended to reduce future flood insurance payouts. And most aspects of floodplain management focus on identifying, assessing, communicating, and mitigating *existing* risk, because flood insurance is required and rated on that basis.

**Shifting the Paradigm**

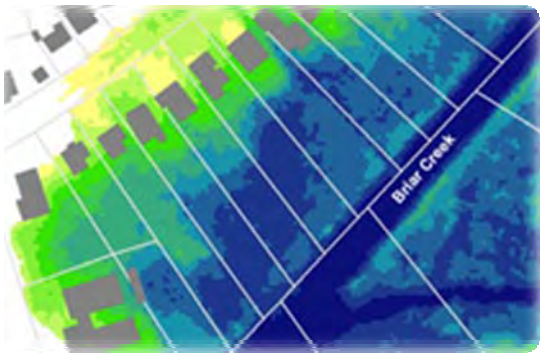
When considering the effectiveness of and/or changes to federal, state, and local risk reduction programs, we should step back and look through a different lens. Do mapping products driven by flood insurance effectively communicate risk and change behaviors? Do mitigation grant programs comprehensively protect life and property? Will risk continue to increase even if these floodplain management programs are considered to be successful?

The fundamental objective in reducing risk to people and floodplain resources is to change behaviors. Residents and governments must think differently before they act differently. Let's examine a few of these initiatives through a different paradigm.

***Floodplain Mapping: driven by hazard & risk communication***

Flood Insurance Studies (FIS), including the Flood Insurance Rate Map (FIRM), provide hazard information used for requiring and rating flood insurance policies based on the 1% annual chance flood. Over the past 15 years, technological advancements and a desire to better communicate flood risk have created new opportunities within floodplain mapping. However the FIS and the FIRM were developed and are maintained under the paradigm of *flood insurance*. FEMA's Risk MAP initiative has a vision of increasing public awareness and understanding of flood hazards that will lead to action that reduces risk to life and property. A strong case can be made that the FIRM's communicate messages and produce results that contradict this goal. Consider the following:

- The FIRM presents only two levels of flood hazard (1% and 0.2% annual chance flood.)
- Flooding is statistically rare within the Floodplain (only a 1% annual chance of flooding).
- You're either in the Floodplain and have risk, or you're out and do not.
- All property within the Floodplain are shown on the map as having the same level of risk.




- The likelihood and severity of flooding as shown on the map are the same throughout the Floodplain.
- The FIRM is produced on a static map panel, implying that the Floodplain doesn't change over time.

Hazard and risk communication should drive floodplain mapping. FEMA and its partners spend an average of 20% to30% of all floodplain mapping expenses on production of FIRM panels and FIS reports. In their current state, the FIRM and FIS have outlived their useful life. Energy and resources should be focused on producing modernized products that communicate flood hazards in an understandable and meaningful way. Advancements in technology and modes of communication allow for more accurate hazard information to be overlaid with additional community data to show the varying levels of risk to life and property. Once *all* mapping products are produced under the paradigm of flood hazard and risk communication, we can expect behaviors of citizens, government agencies, and elected officials to more holistically change.

***Flood Mitigation: driven by protecting life and property***

Flood mitigation efforts were born out of the desire to reduce the drain on the NFIP. Most grant programs in existence today are funded through the NFIP. Mitigation is critical in keeping the flood insurance program fiscally sustainable while also reducing flood risk. Studies have shown that the average return-on-investment for mitigation projects is two to three times the initial investment. However, the current mitigation grant programs don't adequately account for protection of life and all property. The "benefits," which determine whether a project is eligible for mitigation grant funds, are focused solely on insurable property damage. Consider the following:

- Benefits don't account for potential for loss of life or the reduced quality of life due to frequent flooding.
- Benefits don't include any natural and environmental benefits of the mitigation project.
- Benefit/cost requirements discourage creative mitigation and additional leveraging of state and local cost sharing.
- Benefit/cost requirements eliminate grant-funded mitigation opportunities for some Repetitive Loss structures.
- Mitigation grant programs don't require nor encourage consideration of actions that prevent increases in future risk.

Comprehensive risk reduction should drive flood mitigation rather than the savings to the NFIP. Under this paradigm, more sustainable and innovative mitigation would occur. Flexible mitigation grant programs could give communities the incentive to plan and implement property-specific flood mitigation projects. Mitigation programs driven by considering all "benefits" would result in new and more comprehensive projects that protect life and property. Sliding cost shares for mitigation grant funding could strongly incentivize communities to consider how they manage future growth to prevent flood risk from increasing. And innovative mitigation partnerships with states and/or communities could allow quicker action and reduced costs by implementing opportunistic-type mitigation that takes advantage of disaster damage, property owner interest, changes in economic conditions, etc. Once flood mitigation programs evolve beyond flood insurance-based criteria, we can expect more comprehensive, effective and timely mitigation which will further reduce flood related risk to life and property.

***Floodplain management: driven by keeping one eye on the future***

FEMA's Risk MAP initiative is the most all-encompassing floodplain management strategy developed by the federal government to date. It ties together floodplain mapping, risk assessment, and mitigation planning in a more comprehensive manner. Imagine for a moment if Risk MAP or other future flood insurance driven initiatives allowed floodplain management to quickly reach a utopia. Imagine engineering-based floodplain maps throughout the majority of the country. Imagine minimum floodplain regulations enforced unequivocally nationwide. Imagine updated mitigation plans throughout the United States that address the existing flood risk, followed by completed projects and actions that reduce that risk. Obviously these would be incredible accomplishments and have a huge impact on flood risk reduction. However, these comprehensive and beneficial actions focus solely on identifying and reducing *existing* risk.

Floodplain management professionals agree that flood hazards can change over time due to both manmade and natural causes. This varies regionally and the rate of change is based on both predictable and less predictable factors. Now imagine what flood risk throughout most of the nation might look like in 50 or 100 years:

- Sea level rise has continued and storm surge heights have increased. Structures along the cost that were built according to regulations are at significantly-increased risk.
- Inland development has continued and Floodplains have continued to expand. Structures that were built in compliance with floodplain regulations now flood. Buildings constructed outside the Floodplain are now within it and making flood insurance claims.
- Various infrastructure constructed to meet Floodplain standards is damaged by floods.
- Mitigation grant funds are being spent to acquire, elevate, or otherwise protect buildings that were originally constructed properly.
- Due to the increased flood hazard, previously funded mitigation projects are once again vulnerable and require additional mitigation.

In hindsight, citizens and elected officials wonder why these adverse impacts weren't accounted for in storm water controls, future conditions riverine and costal mapping, or other future mitigation measures.

Reducing existing *and future* flood risk should drive floodplain management programs. Floodplain management driven by flood insurance focuses only on the pavement in front of us, rather than also looking at the map that helps predict what the future has in store. Many potential changes to the floodplain are predictable and even preventable. Looking to the future shouldn't be an afterthought or viewed as a higher standard. We must live in the present while actively planning for the future.

**Changing the Results**

Flood insurance is an incredibly important and valuable component of floodplain management. The National Flood Insurance Act has encouraged positive behaviors, limited unwise increases in risk, and transferred some of the financial risk to those who elect to take it. Core principles of comprehensive floodplain management include protecting public health and safety, reducing damage to property and preventing increases, reducing the risk of erosion, and protecting natural and beneficial floodplain functions. However, we will not be successful in achieving these goals by continuing to solve problems looking through the lens of flood insurance alone.

To effectively manage risk to people and to floodplain resources we must change the paradigm. It's daunting to think about switching drivers after a 40 year journey while moving at 70 MPH down the side of a mountain. But the risk of allowing flood insurance to continue to drive the car is that we'll end up at the bottom of the mountain only to realize we're headed toward the wrong destination. We must consider moving flood insurance into the passenger's seat and take a fresh look at our desired destination through a different lens. That new approach would put risk communication and efforts to reduce future risks in the driver's seat. The result could be a comprehensive, effective strategy for truly managing flood risk and floodplain resources now and in the future.

# Part 4

# Data and Tools for Management of Flood Risk and Floodplain Resources

# MAXIMIZED FLOOD RISK REDUCTION BENEFITS OF RIPARIAN BUFFERS

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As part of a broader flood risk reduction strategy, well-designed processes to create riparian buffers have the potential to satisfy both the demand to reduce disaster impacts and encourage positive growth. However, market pressures and scarce resources require that preservation activities be implemented in the most efficient manner available. In addition, maximizing flood risk reduction benefits requires intentional location and methods of creation as well as extensive outreach efforts to both garner public support and influence property owner decisions in and around the preserved riparian corridors. Simply requiring a building setback from a watercourse certainly has direct flood risk reduction benefits. However, the potential for risk reduction can be much greater when the riparian corridor is preserved or rehabilitated to a natural vegetative state and property owners are compelled to make decisions that allow the riparian corridor to maximize the natural floodplain functions.

Creation of riparian buffer zones can provide a signifcant economic benefit to property owners and encourge community-wide growth. Quantifying the risk reduction value of preserved vegetated riparian corridors is difficult due to the indirect nature of some of these opportunities. However, evaluation can be considered through both avoided costs as well as increased real estate values surrounding the natural amenity. Dissipated peak flows and velocities, balanced sedimentation and erosion processes that help maintain channel location and minimize erosion-based meandering, and groundwater recharge are among the natural functions that can reduce both the number and extent of flood events. The savings associated with avoided flood damages is one of the most straight forward ways to quantify potential value. Reduction in costs are also associated with maintanence of natural flood water storage capacity through reduced stormwater infrastructure costs. Vegetated riparian corridors provide decidedly superior pollutant filtration, and can reduce costs of silt fencing, monitoring, reporting *etc*. that must be borne by both the developer and the community. The cheapest path to improved drinking water quality is preserving the natural function of the vegetated stream corridor.

Community-wide positive growth can be supported by protection of riparian buffers. Many times, the integrity of our natural systems is critical to maintaining the recreation-based tourism sector of the economy. In addition, real estate values are increased simply by proximity to natural amenities such as an unspoiled natural stream corridor. Whether it is a result of the view, access to recreation, the intangible feeling associated with a connection to nature, or some other reason – people will pay more to live near a natural stream corridor. Probably for this reason, many companies consider natural amenities an important part of their criteria for choosing a location. By preserving or rehabilitating a natural stream corridor, the nearby development potential will dramatically increase in value. Of course, simply creating a riparian buffer will not immediately correspond to these benefits. Maximizing the risk reduction benefits

of these buffers requires a number of intentional efforts including prioritized method and location of buffers, public participation in decision-making, implementation of a management plan, and clear connections to a watershed-based risk management strategy.

**Prioritized Method and Location of Buffers**

Strategically locating riparian buffers for optimal risk reduction will require extensive consideration of the unique local characteristics. While there are a variety of possible methods to create riparian buffers, the most efficient method may vary based on development patterns, geography, political constraints, and other factors. Legal adoption of setbacks to establish riparian buffer zones, outright purchase of land, conservation easements deeded to open space, purchase or transfer of development rights and project design that intentionally avoids identified riparian areas are a few options. Buffer zones can be adopted through local zoning, subdivision, NFIP floodplain, or stand-alone ordinances specifically designed to implement buffers. Within these local codes are a variety of forms including overlay or floating zones, specific districts, and qualified easement requirements. Just a few options for establishing regulatory setbacks are single or variable minimums, differing use zones, and watercourse-specific applications. Communities have great flexibility in the application of this type of regulation as long as it can be clearly tied to the health, safety, and general welfare of citizens.

Prioritization of location requires vulnerability analysis to determine which areas most need protection. High development pressure identified by recent growth and anticipated watershed development trends may warrant attention; however, existing or anticipated investments such as infrastructure as well as land characteristics that enable development should also be considered. Of particular importance in identifying priority locations, are protection of environmentally sensitive areas such as headwaters, wetlands, endangered or threatened species habitat, and/or connectivity to these resources. Creating continuous green corridors should be given special consideration for the ability to strategically serve multiple objectives, drastically improved ecological function, as well as their advantage in floodwater absorption and storage capacity. Existing water quality measures can help to identify other highly functioning ecological systems that deserve special consideration including NDPES attainments, high scores on qualitative habitat evaluation index (QHEI) and index of biotic integrity (IBI), or other established measures of quality such as Scenic River or Cold/Warm Water Habitat designations. Especially in the event that a vulnerability analysis shows a particular need for flood risk reduction in an area that does not have an existing high quality watercourse, rehabilitation opportunities should be considered for currently degraded watercourses. Further, uncovering culverted streams through the process of "daylighting" has significant potential for urban areas that are in need of flood risk reduction and are willing to explore creative alternatives.

**Public Involvement in Decision-Making Process**

Putting forth the effort for involving the public as critical stakeholders in the decision-making process of developing and implementing a flood risk reduction strategy is crucial to success. Public participation benefits the process by improving outcomes, enabling politicians to securely make decisions based on the long-term community vision, and garnering public support for bringing these projects into the future. Collaboration with stakeholders allows for the collection of a wide breadth of expertise, historical perspective, and personal experiences that local officials may not otherwise have accessed. In an effort to efficiently and effectively use our scarce resources it is

important to tap into this important knowledge base. Also, full consideration of alternatives in a public forum assists in tailoring solutions to local needs. Without an earnest effort to solicit public input it is difficult for sometimes-controversial land use control efforts to gain credibility. Perhaps most important, long-term support of riparian buffer programs is necessary to maintain the flood risk reduction benefits. If public support is lost the regulatory setback can easily be repealed or maintenance and administrative funding for enforcement can be withdrawn. Emerging from public participation is a sense of shared responsibility for the success of the program.

Half-hearted efforts to involve the public can be counter-productive to these endeavors. Strong facilitation of group discussion as well as providing a valid opportunity to offer input into assessing a range of alternatives is crucial. Citizens must be educated on the actual risk – which is frequently very different than perceived risk – and then provided the opportunity to participate in determining how to best implement a solution. Public skepticism of the actual risk stems from vague information that hasn't been well disseminated. To combat these problems, present a well communicated risk assessment or vulnerability analysis. Public understanding of exactly who and what is vulnerable helps build support for solutions--such as, riparian buffer creation. Enabling personal connection to both the resource and process can grant local officials the political backing necessary to bring about change. Participation strengthens citizen satisfaction and empowers stewardship, which carries maintenance of riparian buffers into the future.

**Implementation of a Maintenance Plan**

A clearly articulated maintenance plan with continual public outreach is critical to capitalize on the full risk reduction benefits of riparian buffers. Local efforts will be maximized by proper management of the protected lands and surrounding areas. With most riparian buffers this requires that property owners make choices in land use that are compatible with maintaining the natural vegetated state. While enforcement may be an option, it requires administrative authority and physical access to maintain the desired vegetative state once it has been achieved. Funding should be built into the maintenance plan to allow for some upkeep of riparian species, invasive species control, marking boundaries of protected land and general enforcement of maintenance. Aggressive public education and outreach efforts on maintenance, allowable and prohibited uses, as well as best management practices can be built directly into the funding mechanism. Strong disincentives for returning the land to production or development should be clearly laid out.

Support for local efforts in creating vegetated riparian buffers as part of a comprehensive risk reduction strategy can be found through watershed-level management. Finding holistic solutions to mitigating adverse development impacts is most successful when conducted as a multijurisdictional effort where both Priority Conservation Areas and Priority Development Areas are identified and incentivized. In this way, watershed-level management can also help to reduce the strains of regional competition through alignment of policies. By combining resources and reducing political fragmentation, many challenges to implementing risk reduction solutions can be overcome. Cohesion amongst jurisdictions in adopting riparian buffers enhances recreational value, which boosts citizen satisfaction and support; improves ecological function, thus improving flood reduction capabilities; and overall maximizes the monetary investment of the program. Clearly, a flexible approach driven by public demand for efficient sustainable solutions to flood risk is needed. As part of cooperative watershed-based planning efforts to reduce flood risk, the benefits of vegetated riparian buffers can be maximized.

# DEMOGRAPHICS, DENSITY, AND DISASTERS

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## I. Introduction

"Floods are 'Acts of God', but flood losses are largely acts of man[1]."

Economic damage results from an interaction between flood waters and human activities in flooded areas, so one must consider changes in population and development in anticipating what future flood damage levels may be. This paper looks at demographic trends in relation to increased flood damages in the United States.

It is evident from population statistics that our world is changing. Our population continues to grow and become more diverse. Urban populations continue to increase, while we see very little rise in rural areas, resulting in denser populations in more risk-prone areas. These demographic changes affect housing, education, the labor force and exposure to flood risks, and scientists now link increases in flood damages to societal factors, such as population growth and density, rather than increased precipitation or more detailed reporting.

Since flood losses result from an interaction between floodwaters and human activities in the flooded areas, we must consider changes in population and development in analyzing potential flood damage over time.

**The future of preparing for and recovering from natural disasters in the United States is thus tied to recognizing and responding to demographic and population changes happening in America as well as historical climate and past weather disasters.**

## II. A Growing Population

National census data serve as the foundation for measuring populations at risk from the impacts of natural or human-induced disasters. Improvements in subnational data are vital to enhance decisions on risk identification, risk reduction opportunities, disaster relief, and long-term development assistance to populations vulnerable to a wide range of hazards potentially leading to disasters.

The United States population reached approximately 304 million by 2008, an increase of roughly 8 percent or 22.6 million from 2000 to 2008[2]. If the U.S. continues to grow at this rate, the population is projected to reach 400 million by 2039 and 439 million in 2050[3].

Some examples of significant state growth are:

- By July 1, 2008 the population in **Texas** had increased to 24.3 million persons by 16.7 percent since April 1 of 2000 (the census date)[4]. Texas growth is the most substantial, increasing by nearly twice the national percentage of growth rate.[5] It is also led all other states in terms of total numerical growth, increasing by more nearly 3.5 million between 2000 and 2008[6].
- **California** was the second fastest growing state, with roughly 2.9 million in added population[7].
- **Alabama** increased by 4.8 percent to nearly 4.7 million by 2000[8], and **Mississippi** increased by 3.3 percent to 2.9 million in 2008[9].

## III. Population Diversification (Race/Age/Housing)

Our Nation's population is projected to continue to increase, diversify rapidly and age substantially in the coming years. Current and projected changes in the population suggest that the individual states and the United States overall, will be characterized by increasing diversity, especially in the school-age population and subsequently the labor force. Further, there is every reason to believe that immigration will continue despite the fact that current growth levels have decreased somewhat due to the recent recession.

### A. Racial Diversity

The implications of demographic change for the future of the nation as a whole and states such as Alabama, Louisiana, Mississippi, New Mexico, and Texas[10] are extensive[11].

Population growth in the United States, as in Texas and other high growth states, is increasingly due to growth in non-Anglo or minority population groups. Today, non-Hispanic White Americans make up about 66 percent of the population, but this percentage is expected to fall to 46 percent in 2050[12]. In contrast, the Hispanic and Latino population is expected to rise from 15 percent to 30 percent by 2050[13]. African Americans make up 14 percent of the population in 2010, and in 2050 they are projected to comprise 15 percent, while the Asian American population is expected to increase almost four percent over the same time period[14]. Table 1 depicts this changing demographic while Figure 2 displays the percentage of Hispanics in the U.S. based on the 2000 Census.

**Table 1 – Census Population Projections**

| U.S. Census Population Projections | | |
|---|---|---|
| | **2008** | **2050** |
| Non-Hispanic whites | 66% | 46% |
| Hispanics | 15% | 30% |
| African Americans | 14% | 15% |
| Asian Americans | 5% | 9% |

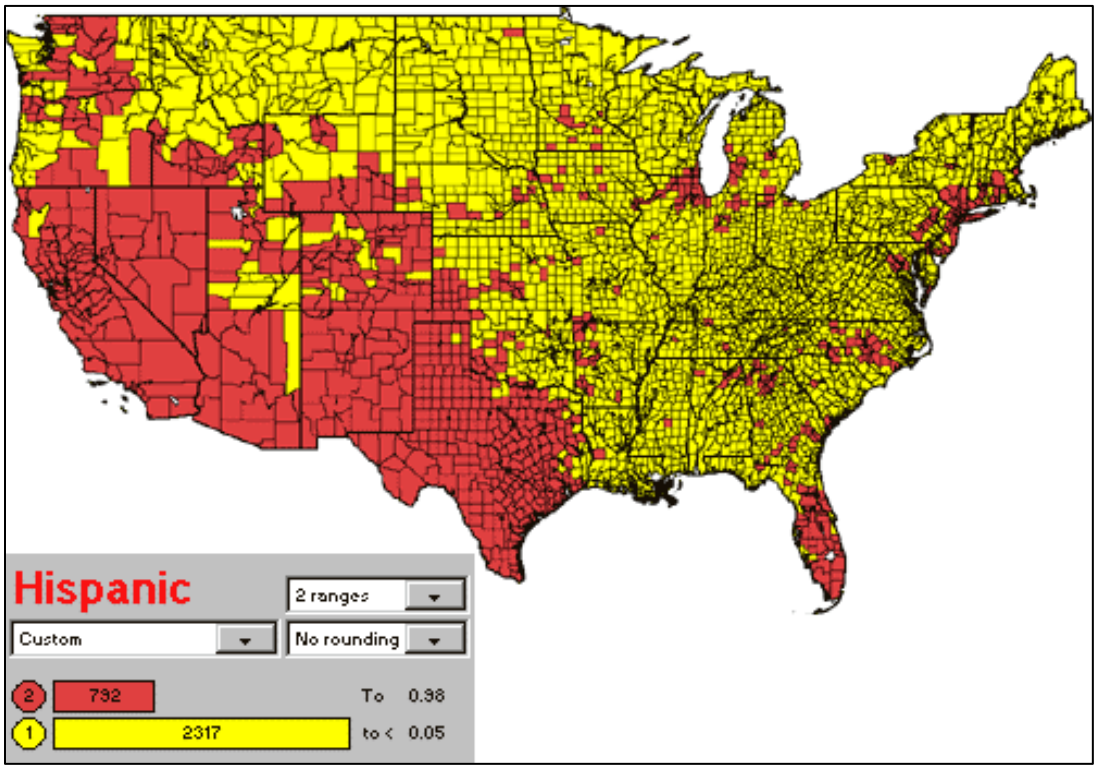



**Figure 2 - Hispanics as a Percent of Total Population (Census 2000)**

**Consequently, the United States population is projected to be less than one-half Anglo by 2042 and by 2023 more than one-half of those under 18 years of age will be non-Anglos.** By 2050, roughly 30 percent of the U.S. population will be Hispanic, only slightly less than the percentage in Texas population in 2000.

### B. Diversity Among Age Groups

By 2030 in the United States, roughly 20 percent of the populations will be 65 years of age or older, up from about 12 percent in 2000[15]. The population of the United States is aging with median age increasing as the Baby Boomers, those born between 1946 and 1964, are moving into later middle age and early elderly age groups.

In 2000, only about seven percent of the labor force or roughly one in 12 workers was 60 years of age or older; by 2050, 11.2 percent or roughly one in nine workers will be 60 years of age or older[16]. Of this older-work segment, only one in seven will be Anglo.

Because Baby Boomers are disproportionately non-Hispanic White (while younger populations are disproportionately made up of minority population members), the populations of the states and the Nation as a whole are increasingly made up of older non-Hispanic Whites and younger minority group members with clear implications for different forms and types of services and homes.

## C. Housing Projections

A current trend among the states is an increase in the number of household couples, despite a decrease in household size. Although households are growing in number the size of the family is decreasing. This trend is due in part to longer life expectancy and smaller families. In the 1960s and 1970s, in the heyday of suburbia, 81 percent of households were family households[17]. By 2000, however, this percentage had dwindled to 69 percent of all households[18]. In addition, the percentage of households comprised of married couples with children decreased from 40 percent in 1970 to 24 percent in 2000[19]. It is predicted that this trend will continue with the percentage of households with children declining to almost 12 percent by 2030[20].

Another cause for the burgeoning number of households is the increase in foreign-born immigrants who have arrived in the U.S. between 1980 and 2005. In 1960, the difference between foreign-born immigrants with households and the share of the immigrant population as a whole was roughly four percent[21]. However, as the population of foreign-born immigrants increased, so did the percentage of minority home buyers. Minority home purchases accounted for 60 percent of all first-time home buyers[22] in the 1990s, and by 2000, the difference between immigrants with households and the entire foreign-born population had decreased to less than one percent[23].

Despite a recent decline, the foreign-born population is expected to continually increase, which will impact household patterns. Factors that influence settlement patterns of new immigrants include: language, location (central city, urban, rural), proximity to country of origin, and the existence of earlier migrants at a destination. Based on Census data, foreign-born immigrants are more likely to live at high densities and in multi-family structures (See Figure 3).

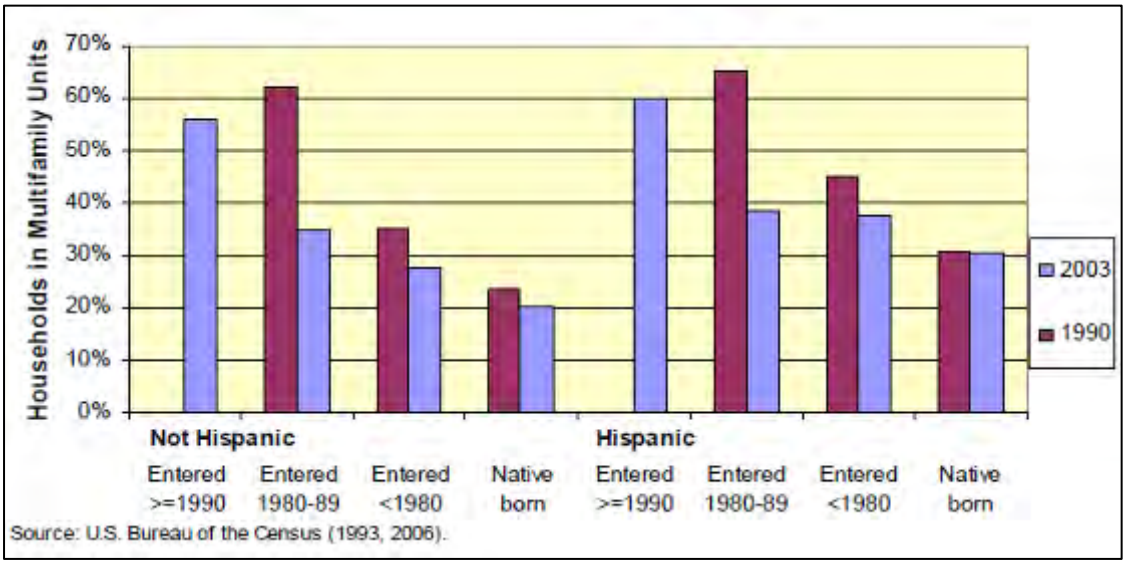



**Figure 3. Households in multifamily units, by origin and nativity of householder, 1990 and 2003.**

A nation's stock of housing is determined by demographic factors and income, and for the first time in history, the U.S. population is projected to be roughly evenly distributed among different age cohorts, instead of the typical pyramid. **As the existing population ages and preferences for fewer children prevail, a larger proportion of majority households will be without children.**

This means that non-Hispanic Anglo households will be smaller in size than ever before with growing numbers of elderly households. More family-structured households will be minority households in denser, metropolitan areas.

**IV. Density**

In construction, urban sprawl has been a reality of development plans of the past. Urban sprawl occurs where there is building on all available land, without regard for environmental impact. There has been a pattern of widespread, low-density residential and commercial settlements with increasing dependence upon automobiles and little or no centralized planning or control of land use until after the damage has been done. The concept of "BANANA" (Build Absolutely Nothing Anywhere Near Anyone) resulted in plots of land around houses with long driveways. Politicians' creeds of "NIMTOO" (Not In My Term Of Office) are shorthand for a reluctance to endorse, change or espouse a potentially unpopular development point of view in an election cycle.

The post-2000 period has witnessed a slowdown in rural population growth (i.e., nonmetropolitan) areas. In fact, even if extended to the entire decade of 2000-2010, the rate of growth in nonmetropolitan areas will be roughly one-third of that in the 1990s[24.]
From 2000 to 2004 the U.S. foreign-born population increased by 24 percent, which was accounted for by two of the cities with the highest population densities, Los Angeles and New York[25].

This trend is not specific to immigrants, as Arthur C. Nelson, co-director of the Metropolitan Institute at Virginia Tech predicts that growing numbers of Americans will likely concentrate in major metropolitan areas and the less populated areas surrounding the cities[26]. This brings land use planners opportunities, but also a plethora of challenges.

While the U.S. continues to grow in population, space itself is not the issue as this country is settled at a low density compared to most other nations. From a space perspective, land areas over the United States can absorb more people if distributed; however, we see that **more than half of Americans live within 50 miles of the Atlantic, Pacific, Gulf and Great Lakes coasts on just a fifth of the country's land area, according to Census data**. By 2025, this number is expected to increase to 75 percent.

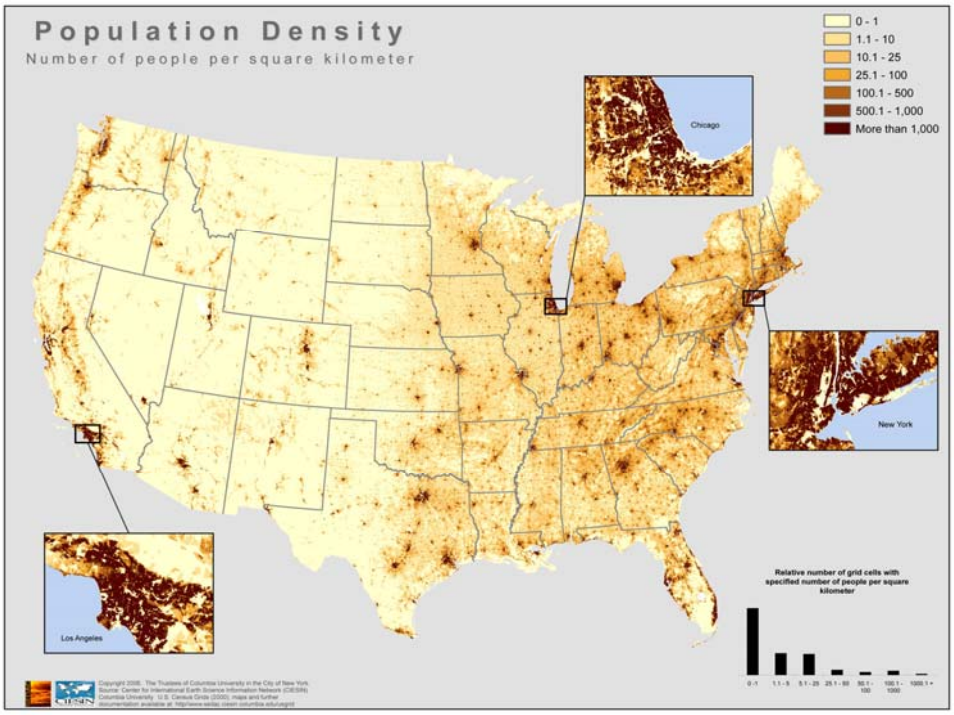
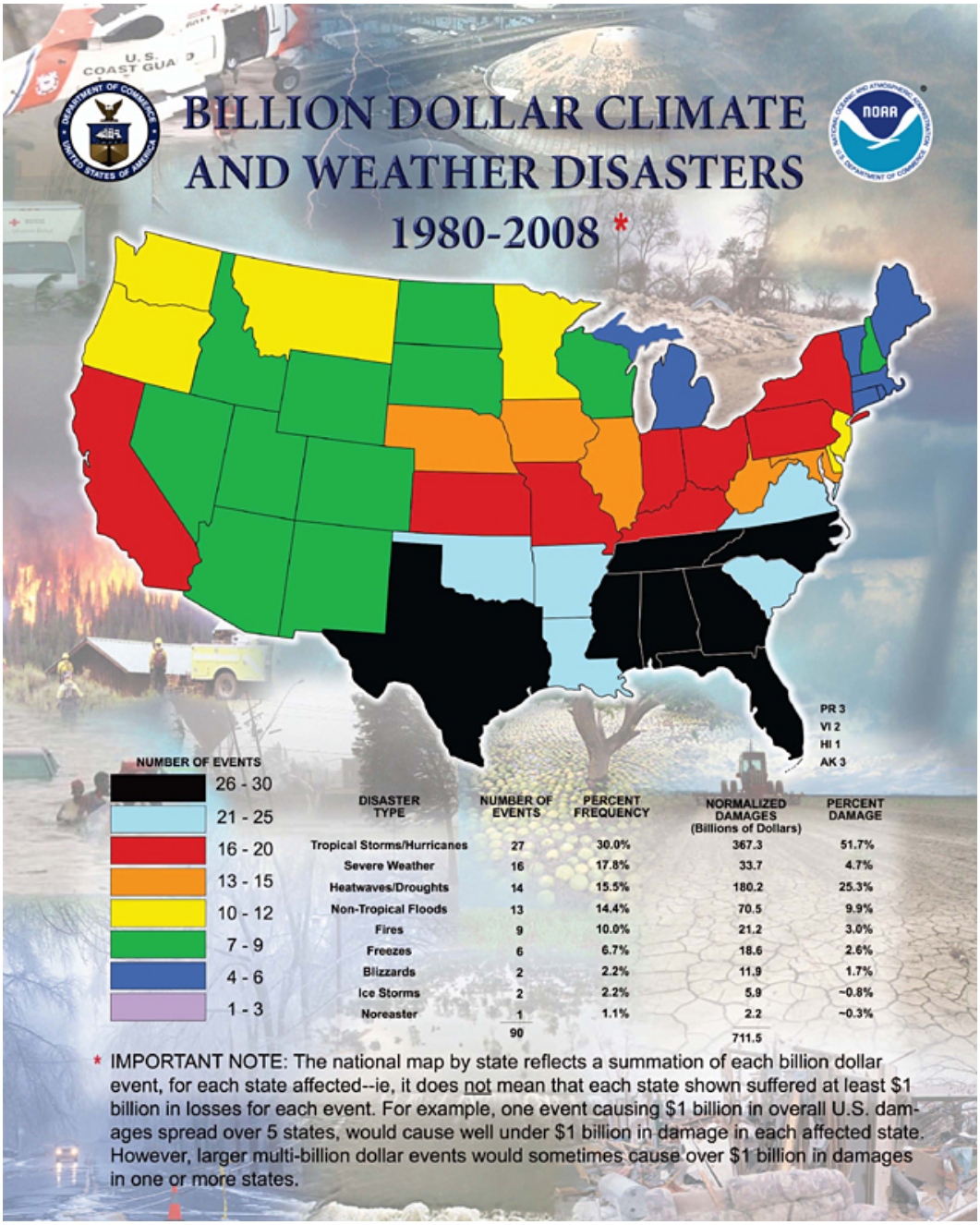



**Figure 4 – Population Density**

## V. Population and Disasters

Challenges for planners include mitigating disasters for populous areas. Figure 5 displays the number of billion dollar natural hazard events by state. Texas, which leads the nation in population growth, has the highest number of Presidential Disaster Declarations from 1953 to 2009[27].

Figure 6 depicts flood risk by state. States with high vulnerability for flooding are those with floods in most years with damages exceeding about $8 million dollars in the majority of years. Flood damage over $100 million dollars occurs frequently in **California, Missouri** and **Texas,** and states with the highest flood losses include **Texas, Louisiana and Florida** as shown in Table 2.




| DISASTER TYPE | NUMBER OF EVENTS | PERCENT FREQUENCY | NORMALIZED DAMAGES (Billions of Dollars) | PERCENT DAMAGE |
|---|---|---|---|---|
| Tropical Storms/Hurricanes | 27 | 30.0% | 367.3 | 51.7% |
| Severe Weather | 16 | 17.8% | 33.7 | 4.7% |
| Heatwaves/Droughts | 14 | 15.5% | 180.2 | 25.3% |
| Non-Tropical Floods | 13 | 14.4% | 70.5 | 9.9% |
| Fires | 9 | 10.0% | 21.2 | 3.0% |
| Freezes | 6 | 6.7% | 18.6 | 2.6% |
| Blizzards | 2 | 2.2% | 11.9 | 1.7% |
| Ice Storms | 2 | 2.2% | 5.9 | ~0.8% |
| Noreaster | 1 | 1.1% | 2.2 | ~0.3% |
| | 90 | | 711.5 | |

**Figure 5 – Billion Dollar Disasters by State**

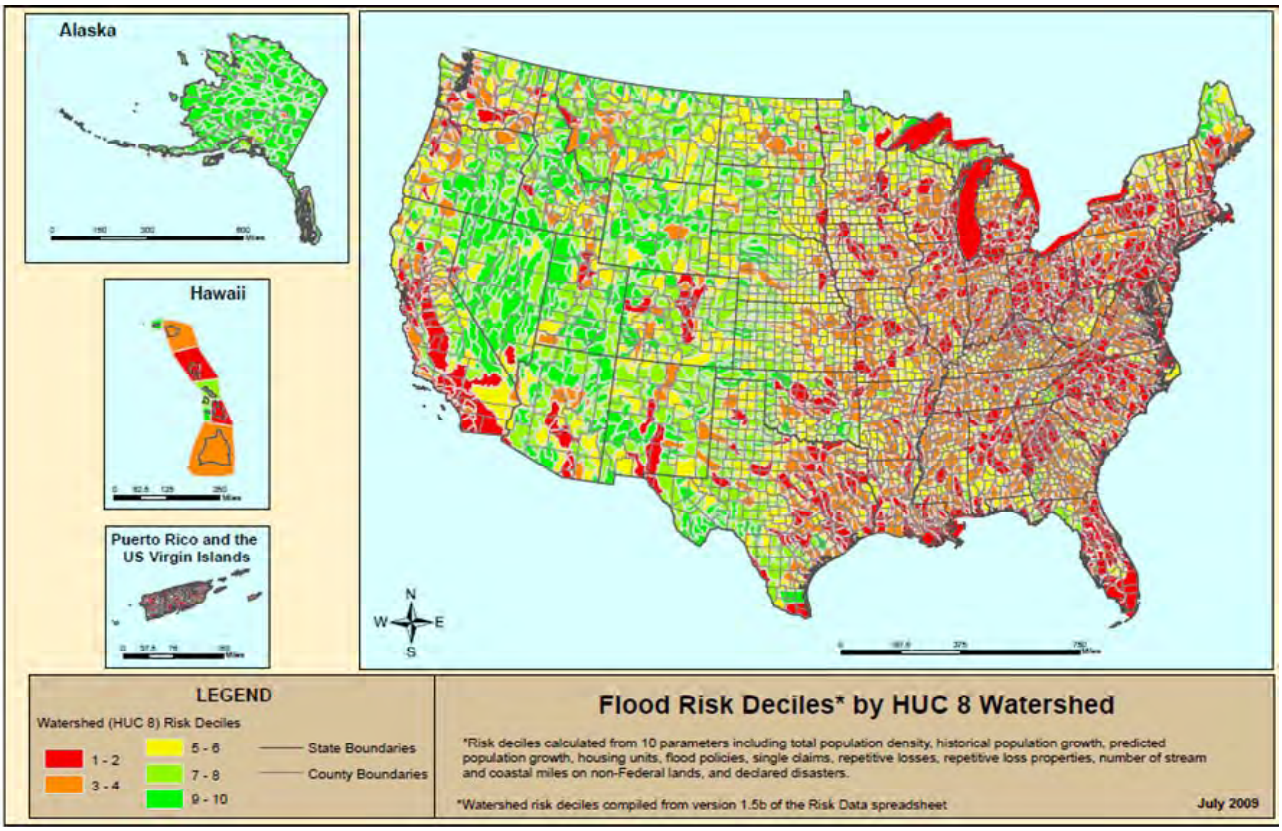



**Figure 6 – Flood Risk by State (2009)**

**Table 2 - U.S. Flood Insurance Loss Statistics (Jan. 1, 1978 – Sept. 30, 2001)[28]**

| Ranking | Total Payments |
|---|---|
| 1. Texas | $2,249,450,933 |
| 2. Louisiana | $1,542,959,989 |
| 3. Florida | $1,479,585,524 |
| 4. New Jersey | $577,019,344 |
| 5. North Carolina | $550,946,544 |
| 6. South Carolina | $414,951,356 |
| 7. Missouri | $407,742,372 |
| 8. New York | $360,534,936 |
| 9. California | $353,244,485 |
| 10. Pennsylvania | $313,186,522 |

Flooding comprises 90 percent of all natural hazards according to the Government Accountability Office, and damages due to floods increase each year. Despite advances in hazard reporting, the National Climatic Data Center (NCDC) attributes the increase in damages to population and density rather than improvements in reporting or climate change. Scientists at the National Center for Atmospheric Research (NCAR) also found that dramatic increases in annual U.S. flood damages from the 1940s to the 1990s were due more to social changes than to increased precipitation[29]. These NCAR scientists determined that population growth alone accounted for **43 percent** of the rise in flood damages from 1932 to 1997, with a much smaller effect from increased precipitation.

NCAR scientists examined ten different measures of precipitation and found a strong relationship between flood damage and the number of two-day heavy rainfall events and wet days. However, this correlation alone could not explain the dramatic growth in flood losses—from $1 billion in the 1940s (adjusted for inflation) to $5 billion in the 1990s[30]. Most of the other increase was due to enlarged national wealth and more detailed disaster reporting[31].
As the population continues to rise, so will the exposure to risk[32]. Even with unpredictable climate changes, environmental protection and structural mitigation actions can help to reduce vulnerability.[33]

**Other studies of hurricanes and heat waves lead to a similar conclusion: socioeconomic trends, not climate change, will continue to drive increasing disaster losses.**

Cost of disasters will continue to rise. As the intensity and frequency of natural hazards continue to grow—so do the price tags associated with these losses. Figure 6 shows a significant jump from the $29.9 billion cost of natural perils in the 1980s to the current $176 billion of the present decade; with experts predicting damage levels to reach $1 trillion by the 2040s.

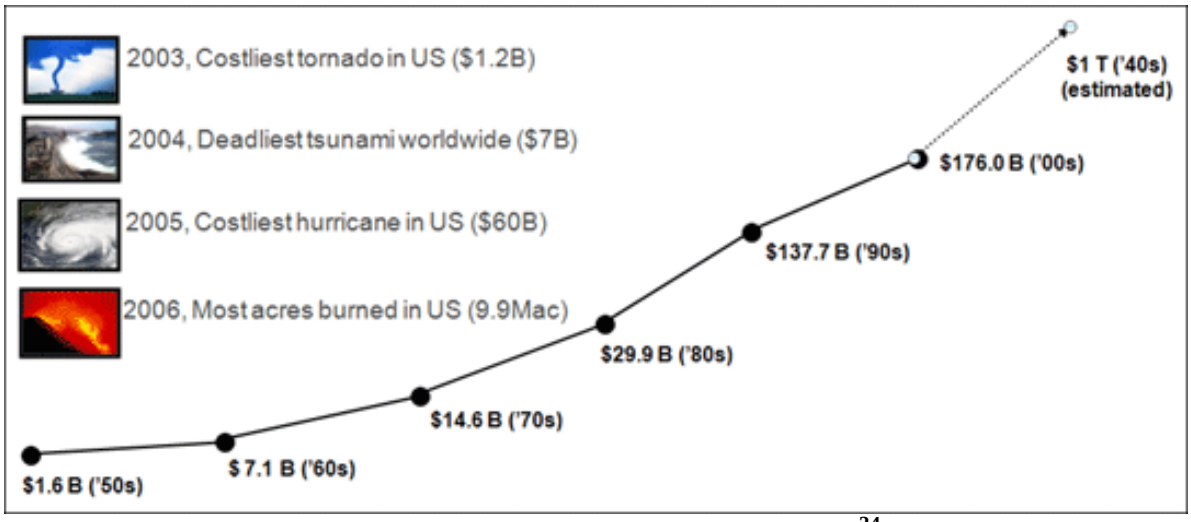



**Figure 6 - Increase in Disaster Cost[34]**

Most tools needed to reduce disaster vulnerability already exist, such as risk assessment techniques, better building codes and code enforcement, land-use standards, and emergency-preparedness plans. The question is: Why is disaster vulnerability so low on the list of development priorities? This author proposes that the most serious flaw in our current efforts is the lack of a consensus standard of acceptable disaster vulnerability of a political jurisdiction, and an action plan to put our country on course to achieve this standard. Then, we would have a means to measure progress and to make it clear which areas are doing well and which are not. Disaster mitigation policies regarding floodplain management are available and can curtail rising costs without waiting for more climate change research because "**we know enough to act now**.[35]"

Although warmer climate can lead to more heavy-rain events, "even without an increase in precipitation…flood damage will continue to rise with the nation's growing population and wealth unless actions are taken to reduce vulnerability.[36]"

## VI. Conclusions/Future Studies

Based on academic analysis and modeling, experts predict that the United States population will be more diverse, and products and services, including housing and our efforts at educating/ incentivizing land-use policy makers toward more investment in sustainable development, will need to include messaging directed to specific characteristics of the emerging population groups and patterns of household development.

We will have not only more people in U.S. high hazard areas, but they will be older and more culturally diverse. Housing will meet the demands of these 21st Century Americans–but what kind of housing will be built and added to the existing housing stock? Where will new housing be located? Will some or much of the costs for locating in high hazard areas be shifted by means of insurance and government programs?

**We do not have time on our side as population demographics and density are changing rapidly. Not all change is negative, but to be prepared to mitigate certain hazards, we must first understand the magnitude of the risks we face collectively**.

The costs of government programs enacted to rescue those who suffer losses due to natural hazards are borne by taxpayers and through private risk spreading mechanisms such as insurance programs and companies, risk pool assessments, guaranty funds and other entities that, in turn, recoup outlays by raising product costs to consumers (generally by increasing insurance rates).

The Association of Floodplain Managers has been a leading organization dedicated to reducing loss of lives and property by promoting education, policies, and activities that mitigate current and future losses, costs, and human suffering caused by flooding, and to protect the natural and beneficial functions of floodplains - all without causing adverse impacts. ASFPM's sponsorship of the 2010 Gilbert White Symposium is evidence of its commitment to this mission.

We propose areas which deserve further research and study regarding demographics, density and disasters. The disciplines of social scientists, demographers, engineers, geographers, land use planners, and climatologists should coalesce to confront the challenges of examining population projections and disaster expectations.

## VI. Suggested Future Research

There is a diverse range of issues regarding population and natural disasters, including flooding, where further research can be valuable, among which are:

- The nexus between trends in housing patterns and pre and post disaster activities with positive cost/benefit ratios should be examined in order to target information and assistance for the most cost-effective activities.
- More in-depth analysis of trends using 2010 census data should be conducted to better understand the motivations and causes of geographic concentration and mobility of segments of the population, including minorities.
- An application of the findings from geographic concentrations and population projections on exposures to natural disasters and methods of slowing the economic effects of increased risks of higher concentration and density of populations in high hazard areas.
- How to more effectively develop and provide communication of natural hazard risks through messaging directed to specific characteristics of the emerging population groups and patterns of household development as well as to populations who have moved into areas without knowledge of historical natural hazard risks and current mitigation measures.
- Development of a baseline standard of acceptable disaster vulnerability of a political jurisdiction, to serve as a basis for an action plan to put our country on course to achieve and surpass this standard.

**Acknowledgements:**
Special thanks to Steve H. Murdock, Ph.D. for important contributions to this paper and independent data checks. Dr. Murdock is a Professor in the Department of Sociology at Rice University, who previously served as the first official State Demographer of Texas and headed the Texas State Data Center and Texas Population Estimates and Projections Program for more than 25 years. President George W. Bush nominated Steve Murdock for director of the U.S. Census Bureau on June 18, 2007, and the Senate confirmed him unanimously on Dec. 19, 2007. Erin Capps, legal counsel and H2O Mitigation Manager's assistance was invaluable in preparing this paper. I thank her, too.

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# CHALLENGES TO CODE ADOPTION AND ENFORCEMENT

**Michael Armstrong**
***International Code Council****

**Introduction**
The utilization of codes as a primary tool for floodplain management has been a centerpiece of national policy for several decades. However, economic stresses and the continued reliance on engineered solutions are frequently used as an argument for a dilution or abandonment of codes to regulate construction and land-use. Further, the evolution of codes into non-traditional areas such as sustainability is creating resistance within the community of code officials, either on an ideological or intellectual basis. These twin realities, unless countered with a continued, effective effort to engage decision-makers and educate new generations of multi-disciplinary experts, will result in the creation of new vulnerabilities to human and floodplain resources.

**Overview and Examples**
A significant segment of those impacted by Hurricane Katrina argue that given the reliance of greater New Orleans on an effective levee system, the only future solution to effective risk management is increasing the strength and sophistication of the system itself. The challenges of history, culture, race and politics, with the nuances of tourist and self-sustaining economics blended in, confound any sense of real progress in a new approach to managing risk that prioritizes land-use planning, stricter codes and code enforcement, and incentives for new urban design approaches. Anecdotal examples of "Make it Right" and similar projects aside, the reflex toward engineered solutions is alive and well.
Current federal recovery and mitigation programs do not collectively drive policy in an enlightened direction. As a participant in a recent roundtable on federal disaster recovery policies hosted by the Brookings Institution and chaired by the White House Office of Domestic Policy, I observed a consensus around the idea that unless several changes occur we will continue to have a largely stagnant federal capability:

- More flexibility must be given state and local government
- Cross-departmental compatibility must be achieved to maximize available funds and technical support
- A new culture emphasizing community organizing, economic development, land use planning and a multi-disciplinary orientation will be needed at the federal level, which is counter-intuitive to the Incident Command System culture which is best applied to response and preparedness.

These references to a continued emphasis on engineered solutions and incident command bias argue for a fundamental change in both the manner in which policy utilizes codes and in the type

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** The opinions expressed in this paper are strictly those of the author and do not represent an official position of the International Code Council.*

of leadership that is provided at the policy-making level. Within the floodplain management community, there is great familiarity with the many "success story" examples of effective use of codes and effective exercise of leadership. But we have yet to see national criteria that incentivize making these success stories the norm rather than the exception.
Within the code community itself, recent emphasis on "newer" areas such as energy conservation and green construction has been met with inconsistent support. Anecdotally, actual enforcement of other model codes those addressing land-use planning are similarly viewed by purists as secondary or, even worse, as "soft" or inconsistent with a mission of promoting building safety. These conditions have been measured by recent internal survey documents managed by the International Code Council, as well as by member feedback instruments and interviews.
Similar to the above conclusions regarding fully realized utilization of codes and the requisite leadership orientation, the code community's evolution toward more diverse and complex options to regulate building safety and sustainability beg the same set of concerns. Without a means to argue for, and incentivize a fully realized set of codes, an "unholy alliance" between recalcitrant code officials and industry obstructionists will create a risk reduction stalemate.

**Conclusion**

The Obama Administration is interested in exploring new approaches to a more sustainable policy to reduce the risks of disasters. There is an opportunity to present a well-stated set of proposed revisions to legislation, rules, and policies that should include utilization and demonstrated enforcement of specific codes as criteria for federal support. To fully realize this, an assessment of needs and capabilities should be conducted to move us beyond an "adopt and forget" mentality. This can directly translate to job creation in the area of code specialists, training, the certification of expertise, accreditation of public agencies and industry, and the inspection of construction and land-use decisions.

# ENCOURAGING ADAPTATION TO CLIMATE CHANGE: LONG-TERM FLOOD INSURANCE


## Howard Kunreuther and Erwann Michel-Kerjan
***The Wharton School, University of Pennsylvania***



*This paper was originally published as Issue Brief 09-13 of Resources for the Future, an independent, nonpartisan think tank that, through its social science research, enables policymakers and stakeholders to make better, more informed decisions about energy, environmental, natural resource, and public health issues. Headquartered in Washington, DC, its research scope comprises programs in nations around the world.*


As defined by the Intergovernmental Panel on Climate Change, adaptation includes a set of actions to moderate harm or exploit beneficial opportunities in response to climate change. To date, little research has addressed public policy options to frame the nation's approach to adapt to a changing climate. In light of scientific evidence of extreme and unpredictable climate change, prudent policy requires consideration of what to do if markets and people fail to anticipate these changes, or are constrained in their ability to react. This issue brief is one in a series that results from the second phase of a domestic adaptation research project conducted by Resources for the Future. The briefs are primarily intended for use by decisionmakers in confronting the complex and difficult task of effectively adapting the United States to climate change impacts, but may also offer insight and value to scholars and the general public. This research was supported by a grant from the Smith-Richardson Foundation.

**Policy Recommendations**

The severe hurricanes in Florida in 2004, Hurricanes Katrina, Rita and Wilma in 2005, and Hurricane Ike in 2008 clearly demonstrate that the United States is highly vulnerable to large-scale risks from storm surge and flooding. Given the possibility of sea level rise due to global warming, we are entering a new era of catastrophes unless the increasing number of property owners located in coastal areas invest more in risk-reduction measures (adaptation measures) than they do today. In this context, the current debate about how best to adapt to a changing climate raises an important policy question: how can the United States sustain itself against more devastating climate-related natural disasters in the future? Focusing on the flood risk, we recommend that Congress and the Administration revise the 1968-established National Flood Insurance Program (NFIP), which covers more than $1.2 trillion of assets today, by moving from annual insurance contracts to long-term policies tied to property. Such a change will encourage people in high risk areas to think more about the long-term and invest in cost-effective adaptation measures that reduce losses from future floods and hurricanes.

**What Losses Can We Expect?**

Between 1970 and 2004, storms and floods were responsible for more than 90 percent of the total economic costs of extreme weather-related events worldwide. Hurricane Katrina, which hit

Louisiana and Mississippi at the end of August 2005, killed 1,300 people and forced 1.5 million people to evacuate the affected area—a historic record for the country. Insured losses to the private sector from this hurricane have been estimated at $48 billion in 2008 dollars (Kunreuther and Michel-Kerjan 2009) with an additional $17 billion dollars paid by the federally run National Flood Insurance Program—another record (Michel-Kerjan and Kousky forthcoming).

A series of hurricanes in 2008 caused billions of dollars in direct economic losses along the Caribbean basin and in the United States. Hurricane Ike was the most expensive individual event in 2008, with an estimated privately insured loss of $17.6 billion in addition to $2.4 billion in claims paid by the U.S. National Flood Insurance Program (NFIP) for related storm-surge water damage (Swiss Re 2009).

Of the 25 most costly insured catastrophes worldwide between 1970 and 2008, 17 occurred in the United States. Fourteen have occurred since 2001, 12 in the United States. Given these events, it is hard to believe that 20 years ago, when Hurricane Hugo hit South Carolina, it was the first catastrophe to inflict more than $1 billion of insured losses.

Several elements explain this increase in the costs of disasters in recent years. They include urbanization of the population, an increase in the value at risk and density of insurance coverage, and the possible impact of global warming on the frequency and severity of hurricanes.

For indications as to why losses from natural disasters have increased so rapidly, one need only look at Florida. The 1,200 miles of coastline that make the state an attractive destination for tourists and retirees also make it vulnerable to impacts by hurricanes from the Atlantic, Gulf of Mexico, and Caribbean. Although this threat has long been a part of life in the state, the economic impact of the storms was historically limited by the sparseness of the population. In 1950, the state was only the 20th largest in the country with a population of 2.8 million. The years since then have witnessed a migration boom, so that the state is now the country's fourth largest, with a projected 2010 population of 19.3 million (a 600 percent increase since 1950).

One consequence of this trend is clear: hurricanes, which in the past inflicted relatively little property damage, are now potential sources of catastrophe. It has been conjectured, for example, that if the intense hurricane that hit Miami in 1926 were to make landfall in the same area today, it would cause economic losses dwarfing those of Hurricane Katrina (Pielke et al. 2008). And this increased exposure is not unique to Florida. As of December 2007, Florida and New York each had nearly $2.5 trillion of insured values located on the coast. The coastal insured value for the top 10 states combined accounts for more than $8.3 trillion (Kunreuther and Michel-Kerjan 2009). Such huge concentrations of insured value in highly exposed areas almost guarantees that any major storm that hits these regions could inflict hundreds of billion dollars of economic losses, unless the residential construction and infrastructures are properly protected by effective adaptation measures.

Experts are debating whether the series of major hurricanes in 2004 and 2005 may have been intensified due to climate change (higher sea surface temperatures). One of the expected effects of global warming substantiated by empirical data is indeed an increase in hurricane intensity (for more information, see Emmanuel, Sundarajan, and Williams 2008; Emmanuel 2008). Higher ocean temperatures lead to an exponentially higher evaporation rate in the atmosphere, which

increases the intensity of cyclones and precipitation. Other studies suggest that El Niño, rather than sea surface temperature, might be the primary driver of more intense hurricane activity (Mann et al. 2009). No matter what the cause, an increase in the number of major hurricanes for a given period is likely to translate into more storms hitting the coasts and more severe damage to residences and commercial buildings.

**Homeowners' Reluctance to Invest in Adaptation**

The combination of increasing urbanization, concentration of value in high-risk areas, and the potential impact of a change in weather patterns highlights the importance of investment in adaptation measures by those in harm's way. Yet the empirical evidence suggests that property owners are reluctant to incur these costs.

A 1974 survey of more than 1,000 California homeowners in earthquake-prone areas, for example, revealed that only 12 percent of the respondents had adopted any protective measure (Kunreuther et al. 1978). Fifteen years later, despite the increased public awareness of the earthquake hazard, the proportion had changed little. In a 1989 survey of 3,500 homeowners in four California counties at risk from earthquakes, only 5 to 9 percent reported adopting any loss reduction measures (Palm et al. 1990). Reluctance among residents of flood-prone areas to invest in adaptation measures has been similar (Burby et al. 1988; Laska 1991).

Even after hurricanes caused extensive damage to large parts of the Eastern seaboard and Gulf coastlines during the 2004 and 2005 hurricane seasons, a large number of residents had still not invested in relatively inexpensive loss reduction measures with respect to their property, nor had they undertaken emergency preparedness measures. A May 2006 survey of 1,100 adults living along the Atlantic and Gulf coasts revealed—10 months after Hurricane Katrina—that 83 percent of the responders had taken no steps to fortify their home, 68 percent had no hurricane survival kit, and 60 percent had no family disaster plan (Goodnough 2006).

This lack of interest in loss reduction even after the most devastating hurricane in the country's history is puzzling, because we know that the expected benefits of many of these measures justify the investment costs. An analysis of the potential reduction in damage from future hurricanes in four states (Florida, New York, South Carolina, and Texas) reveals that if current building codes were applied to all residential property in coastal areas, loss reductions would range from 61 percent in Florida for a 100-year return-period loss to 31 percent in New York for a 500-year loss. In Florida alone, mitigation reduces losses by $51 billion for a 100-year event and $83 billion for a 500-year event (Kunreuther and Michel-Kerjan 2009).

Why do property owners not invest in these measures? Before a disaster, many individuals perceive the likelihood of a flood or hurricane to be low enough that they contend it will not happen to them. They thus see no need to protect their home through insurance or adaptation measures. Individuals also tend to be highly myopic and hence focus only on the expected benefits from an adaptation measure over the next couple of years even though the average life of their property is 30 to 50 years. By not incorporating the long-term rewards from investing in a loss-reduction measure, the up-front costs are likely to appear unattractive. In fact, if one plans to move within the next few years and the value of the property does not reflect the investment in adaptation measures, this behavior makes economic sense.

**The Need for Long-Term Insurance**

When searching for sustainable solutions to make the nation safer with respect to future large-scale disasters, one needs to carefully consider these behavioral elements to create effective policies. As a solution to overcoming the "it cannot happen to me" and myopia problems that make insurance appear unattractive and discourage investment in adaptation measures, we propose multi-year insurance tied to the property rather than the currently-standard one-year policy tied to the property owner. An appropriate starting point for this new initiative is flood insurance – a national program with a single insurer (the federal government) designed to reduce future damage while providing financial protection to disaster victims.

The National Flood Insurance Program (NFIP) was created in 1968 because private insurers viewed flood risk as uninsurable and refused to provide coverage against water damage from disasters. The NFIP has expanded over the years and in November 2009 covered more than 5.5

million flood policies nationwide with a total exposure of $1.2 trillion. Flood insurance is currently sold on an annual basis and is required as a condition for a federally insured mortgage.

One-year flood policies are problematic because many people buy the insurance when they get a mortgage or immediately after a flood, but do not keep the coverage for the long term. For instance, a recent study that tracked the nearly 1 million NFIP flood insurance policies-in-force to cover single-family homes in Florida in 2000 revealed that one-third had been canceled by 2002, and about two-thirds had been cancelled by 2005 (Michel-Kerjan and Kousky forthcoming).

As a result of these cancellations, there are likely to be a large number of uninsured victims after the next flooding disaster. Consider the flood in August 1998 that damaged property in northern Vermont. Of the 1,549 victims of this disaster, the Federal Emergency Management Agency (FEMA) found 84 percent of the homeowners in Special Flood Hazard Areas (SFHAs) did not have insurance, even though 45 percent of them were required to have such coverage (Tobin and Calfee 2005). These individuals considered insurance a poor investment, failing to realize that the best return on a policy is no return (when you have not suffered any loss).

With the NFIP up for renewal in Congress, we propose that consideration be given to long-term flood insurance (LTFI). By tying policies to the length of the mortgage (10, 20, 30 years), insurance will be directly linked to the property. A further step would be to require that all properties in flood-prone areas have coverage, just as auto insurance is required on all vehicles. When a resident moves to another location, the flood insurance policy would remain with the property.

A long-term flood insurance program would offer homeowners in flood-prone areas a fixed annual premium for coverage over a specified period (e.g., 5, 10, or 20 years). If the homeowner moved before the end of the policy period, the insurance contract would automatically be transferred to the new owner at the same cost. Private insurers currently participating in the write-your-own-program would offer a menu of long-term flood insurance contracts on behalf of the NFIP, as they do now for one-year contracts.

**Advantages**

A long-term flood insurance policy would be a significant improvement over the current annual policies from the perspective of all the relevant stakeholders: homeowners, banks, FEMA, and general taxpayers. Furthermore, it does not require a radical modification of the National Flood Insurance Program nor specific appropriations from Congress. Some of the features that a long-term policy provides follow.

*Financial stability for homeowner*. Fixed insurance rates for a multi-year period would provide homeowners with financial stability. Residents in coastal area would know, also, that they are protected against water damage from floods and hurricanes (storm surge).

*Avoiding cancellation of policies*. A long-term flood policy would ensure that people do not cancel their coverage after two or three years, as many do today when they have not suffered losses. Homeowners would also be more likely to make a claim during the life of the policy given that the chances of a flood over any 20-year period is much higher than the annual probability. For example, if a homeowner lives in a high hazard area where the likelihood of flooding next year is 1 in 100, the chances that the property will experience at least one flood during a 25-year period are greater than 1 in 5.

*Time and geographical spread of risk*. If insurance were required of all homeowners in flood-prone areas, the risk would be spread over time and space. Additionally, expanding the policyholder base over what it is today by having all such properties covered would provide much needed financial revenue for the NFIP.

*Encouraging investment in adaptation measures*. Today, many residents do not invest in risk reduction measures (such as elevating the house) because the up-front cost is too high compared with the annual premium reduction they could expect from the NFIP. To complement a long-term flood insurance policy, we recommend that long-term home improvement loans be made available to spread the cost of the adaptation measure over time. For example, a homeowner with a 20-year mortgage and a 20-year flood insurance policy should be able to obtain a 20-year home improvement loan. For cost-effective adaptation measures and risk-based premiums, the financial arrangement would be such that the annual loan payments would be less than the rebate the property owner could obtain from the NFIP in the form of an annual premium reduction because the house is less exposed to flood damage. These risk reduction measures would likely have the added benefit of increasing property values.

*Reducing costs to all interested parties*. Long-term flood insurance coupled with long-term loans should provide benefits to all interested parties. Homeowners are better protected and pay less by investing in risk reduction measures, the NFIP would be less exposed to damage, the bank has safer mortgages, and the general public will have less of its taxes going to disaster relief.

**Guiding Principles**

If Congress and the Administration decide to move forward on this concept, two principles should guide the development of long-term flood insurance. (An alternative would be to revise the price every 10 years, for instance, based on new scientific knowledge regarding the exposure. This would particularly make sense if one expects changes in climate patterns. )

*Principle 1*: *Premiums should reflect risk*. Insurance premiums should be based on risk to provide signals to individuals about the hazards they face and to encourage them to engage in cost-effective mitigation measures that reduce their vulnerability to catastrophes.

The application of principle 1 provides a clear signal of likely damage to those living in flood-prone areas as well as those considering relocating there. Risk-based premiums would legitimize providing discounts to policyholders investing in cost-effective adaptation measures.

*Principle 2*: *Equity and affordability issues should be addressed*. Any special treatment given to homeowners currently residing in hazard-prone areas (such as low-income uninsured or inadequately insured homeowners) should be funded through general public funding and not through artificial insurance premium subsidies. This principle reflects a concern for some residents in high-hazard areas who will face large premium increases if the NFIP adheres to principle 1.

Note that principle 2 applies only to individuals currently living in a flood-prone area. Those being charged subsidized premiums today (for instance because they moved to the house before their community entered the NFIP) would thus pay the full annual premium reflecting risk, however, this cost to the homeowner could be offset by an insurance voucher those residents would receive (similar in concept to food stamps for groceries) reflecting the difference between the risk-based premium and their subsidized premium. Those who decide to move to the area in the future would be charged full premiums that reflect the risk.

**Pricing**

Pricing a long-term flood insurance policy so that premiums reflect risk means taking into account the impacts of global warming (intensity of future hurricanes and sea level rise). There is considerable uncertainty surrounding the estimates of what the risks associated with losses from hurricanes and flooding may be 10, 20, or 30 years from now. There is thus a need for accurate flood maps and for FEMA to update these maps regularly to reflect these long-term changes and define a pricing formula that evolves over time as maps are revised (GAO 2008).

To understand more fully how climate change is likely to affect flood risk in the United States in the coming years and decades, it will be necessary to have a set of realistic scenarios with respect to losses from inland flooding and storm surge from hurricanes that reflect scientists' best estimates regarding climate change. To be of most use to insurers and federal, state, and local governments, these estimates must be informed by answers from experts to the following questions.

- How many major hurricanes (Category 3 or greater) are estimated to form in the Atlantic Ocean in the next six to 18 months (short term) versus in the next 10 to 30 years (long term)?
- Of those hurricanes, how many are estimated to make landfall?
- How far inland is damage likely to extend, and how closely can the storm tracks be predicted?

- Will climate change alter the number and types of storms that strike land? Do today's topological maps accurately reflect risk of inundation?

- How much will sea level rise and how will natural environmental protection (such as wetlands) change over the next half century in five-year intervals in specific parts of our coasts? What effect will these changes have on flooding and storm surges from hurricanes?

Recent analyses by insurers and modeling firms using the latest estimates by scientists studying climate change enable one to undertake simulations as to how alternative scenarios with respect to global warming impact on the price of flood insurance for long-term policies (Heweijer et al. 2009). A recent study by Lloyd's of London (2008) in conjunction with Risk Management Solutions indicated that risk from sea level rise could double the average annual losses from storm surge by 2030.A 2005 study by the Association of British Insurers(ABI)concluded that with a 6 percent increase in wind speeds, average annual losses from hurricane damage in the United States would increase from $5.5 billion to $9.5 billion and losses from hurricanes with a 1 in 200 chance of occurring would increase from $85 billion to $150 billion based on existing properties.

One of the principal findings from these studies is that adaptation measures can reduce the losses from future disasters significantly. For example, the Lloyd's study showed that adaptation could reduce annual losses from storm surge for properties in high-risk coastal communities in the 2030s to below today's levels. This suggests that long-term flood insurance coupled with long-term home improvement loans that give homeowners the incentive to invest in loss reduction measures will make a significant difference in reducing the damage from future floods and hurricanes.

**Conclusion: Moving from the Status Quo**

The evidence on increasing losses from disasters, notably floods and hurricanes, indicates that the current structure of the National Flood Insurance Program is not adequate to cover truly catastrophic floods. It is also somewhat limited in achieving its twin objectives of reducing property losses from future disasters and providing protection to those who suffer severe water damage for a simple reason: many of these residents do not invest in risk-reduction measures voluntarily and cancel their flood insurance coverage if they haven't suffered a loss for several years.

On a complementary note, we need bold, innovative, and transparent programs so that people can understand the nature of the contract. Those who purchase insurance policies often have a difficult time understanding what risks are covered, what risks are not, and the basis for being charged a specific rate. The problem is likely to be compounded for a long-term contract. The opportunity to educate consumers as to the basis for the premiums being charged lies in providing more detail on the nature of the risk covered and the amount charged for different levels of protection. It would be very useful for the NFIP to reveal this information much more clearly so that homeowners will be able to make trade-offs between costs and expected benefits, which is impossible for them to do today. Thaler and Sunstein (2008) argue for this type of disclosure by proposing a form of government regulation termed RECAP (Record, Evaluate, and

Compare Alternative Prices). They recommend that the government require disclosure practices, not in a long, unintelligible document, but in a spreadsheet-like format that includes all relevant formulas.

The flood insurance program should combine the strengths of the public and private sectors and take into account how people make decisions so that proposed solutions will be considered as win-win propositions by the key interested parties.. In designing these programs, one needs to understand how a long-term insurance policy with rates reflecting risk can lead property owners to invest in loss reduction measures when the insurance is coupled with long-term home improvement loans and building codes. Real estate developers, the construction industry, and financial institutions play an important role in promoting this concept. Third-party inspectors will be needed to certify that the adaptation measures are in place and building codes are enforced.

Whether decision makers view long-term flood insurance as an attractive alternative depends on how the program is designed and presented to key interested parties in relation to the current structure of the NFIP. If the stakeholders have a common understanding of the goals and objectives of an innovative and comprehensive disaster management program, we may be able to move away from a status quo that encourages myopic thinking to a long-term strategy for reducing losses in this new era of catastrophes.

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# THE STATE COORDINATOR'S ROLE IN FLOOD RISK MANAGEMENT COMMUNICATIONS

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Each of the 50 states has an identified individual known as the State Coordinator who is responsible for the coordination and implementation of activities at the State level with the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program (NFIP) in his/her State. FEMA performs their floodplain management-related duties through their regional office staff and through the individual state offices headed by the NFIP State Coordinator. As a federal agency, FEMA is responsible for administering programs such as the NFIP, at the national level, and on a consistent basis across the country without recognition of the individual differences, needs, and interests in each State.

Each FEMA Regional Office develops an agreement each year with each of the State Coordinators in their respective FEMA Region. The agreement is called the Community Assistance Program –State Support Services Element (CAP-SSSE) program. This program provides funding to States to provide technical assistance to communities participating in the NFIP and to evaluate community performance in implementing NFIP floodplain management activities. In this way, CAP-SSSE helps to:

- Ensure that the flood loss reduction goals of the NFIP are met;
- Build State and community floodplain management expertise and capability; and
- Leverage State knowledge and expertise in working with their communities.

FEMA Regional Offices and the designated State agency negotiate a yearly CAP-SSSE Agreement that specifies activities and products to be completed by a State in return for CAP-SSSE funds.

Typical CAP-SSSE activities that can be included in individual State agreements include:

- Performance Measurement/Five-Year Plan Updates
- State Model Ordinance Research and Development
- Ordinance Assistance
- Tracking and Reporting Floodplain Management Data
- Community Assistance Visits and Community Assistance Contacts
- Outreach, Workshops, and Other Training
- General Technical Assistance
- Mapping Assistance
- Coordination with Other State Programs and Agencies
- Assistance to Communities in Responding to Disasters.

Most of the activities that are performed by each State under their CAP-SSSE Agreement involve working with the local governments who are participating in the NFIP. Each of these activities has a direct and specific role in the communication of flood risk to local government staff within the State.

With the communication of flood risk coming from FEMA Headquarters, to FEMA Regional Offices, to each State, to individual communities, and ultimately to the public, there are multiple opportunities for things to be "lost in the translation". The key player it seems in this communication process should be the State Coordinator since this position is really the "funnel" of the communication from FEMA to local governments and the public. Ultimately it is the local government staff and public who are closest to being on the ground where implementation actions are taken based on the flood risk communication that has been initiated by FEMA Headquarters, so it is extremely important that they get the correct information and that they understand it completely.

So, it seems that one of the responsibilities that an effective State Coordinator should assume is to ensure that flood risk materials that come from FEMA are such that they can be effectively communicated to local government staff in his/her State. The State Coordinator is much more knowledgeable than any FEMA staff of specifics related to his/her State. In addition, each State is organized differently with multiple agencies having lesser responsibilities for floodplain management than others for communicating flood risk. As a result, flood risk communications are then made, with varying degrees of expertise and overall knowledge, to local communities. The local communities receiving this information are then expected to know, understand and interpret this information for property owners within their political jurisdictions.

The State Coordinator needs to assume the role of ensuring that flood risk information received from FEMA is clear and consistent and to make sure that this information is effectively communicated to local communities. If the State Coordinator does an effective job of the communication of flood risk information from FEMA to local governments so they can pass this on to their individual citizens and property owners, this will go a long way in increasing the effectiveness of flood risk communication.

# GREEN INFRASTRUCTURE AND LOW IMPACT DEVELOPMENT: CRITICAL TOOLS TO REDUCE FLOODPLAIN RISK & PROTECT FLOODPLAIN RESOURCES

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**What are "Green Infrastructure" and "Low Impact Development"?**

The U.S. Environmental Protection Agency's water quality program is currently focusing considerable resources on promoting two related concepts to protect and restore water quality: "green infrastructure" and "low impact development".

"Green Infrastructure" (GI) has been defined in its broadest sense as "an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife". See *Green Infrastructure* (Benedict and McMahon, Island Press, 2006). It has also been used in the past several years to refer more specifically to "green" stormwater management practices in a manner similar to the term "low impact development" (discussed immediately below), while at the same time including broader watershed practices, such as constructed wetlands and land/water conservation, that protect water quality from stormwater runoff.

"Low Impact Development" (LID) may be defined as "the use of systems and practices that use or mimic natural processes to: (1) infiltrate and recharge precipitation, (2) evapotranspire precipitation, and/or (3) harvest and use precipitation, near to where it falls to earth."

GI and LID are intended to reverse the historical trend whereby development has creates vast extents of imperviousness, which causes runoff to greatly increase and ultimately results in the modification of urban and suburban streams to look like this:

As indicated in the picture, the increased and more powerful runoff during and immediately following storm events results in degradation of both the stream itself and the adjacent streambanks and riparian zone.

An example of the application of LID/GI principles to combat this problem is provided by Section 438 of the Energy Independence and Security Act of 2007. EISA requires that all Federal development or redevelopment projects exceeding 5,000 square feet must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow". The President issued an Executive Order in October 2009 that required EPA to publish guidance for Federal implementation of Section 438. The guidance is published at http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf.

**How Can LID and GI Reduce Floodplain Risk?**

By infiltrating precipitation (e.g., using rain gardens, swales, and pervious pavement), evapotranspiring it (e.g., by planting trees and constructing green roofs), or harvesting and using it (e.g., with cisterns and rain barrels), most new developments can generally keep all rainfall up to (and sometimes exceeding) the 95$^{th}$ percentile rainfall event from running offsite. For example, in the area of Washington, DC, the 95$^{th}$ percentile is a 1.5 – 1.7 inch storm. Additional off-site practices such as constructed wetlands can help provide additional storage in for infrequent larger storm events. Many LID/GI practices can be retrofitted even in rather highly developed areas, and a number of Federal facilities, State and local governments, and others have ramped up their efforts to do so in order to protect or restore their local waters. Examples of the most common practices are pictured at the bottom of this paper.

By infiltrating/evapotranspiring/using 1.5 inches or more of rainfall events, LID and GI practices prevent the runoff of that amount, thereby reducing risk and damage to floodplains and infrastructure. In addition, cities that develop water quality programs to address their stormwater control needs by using these practices (in lieu or to supplement more traditional stormwater infrastructure) inevitably become more aware of the mutual relationship between water quality protection and floodplain protection. This makes them better partners for the floodplain community in determining how to reduce runoff from portions of the watershed that contribute runoff to the floodplains as well as how to protect and preserve floodplains for flood prevention purposes.

**How Can GI and LID Help Protect Floodplain Resources?**

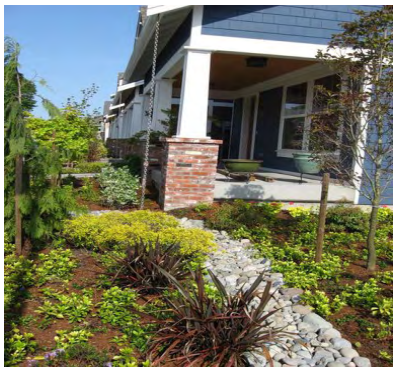
As indicated by the photograph above, current "conventional" stormwater control practices that do not focus on water quantity reduction practices often fail to adequately protect streams, including those in the floodplain, from physical destruction caused by the sheer force of high-volume flows. River and stream banks are severely eroded, resulting in filling their lower portions with silt and reducing the ability of the floodplains to perform their flood prevention functions as well as their habitat protection functions.

Literally hundreds of studies have catalogued the many elements of the damage that development and associated imperviousness causes to urban and suburban waterways. These include increased pollution (nutrients, sediments, metals, etc.); sharply reduced flows during the periods between storms; reduced and less diverse fish and macro-invertebrate populations; increased temperatures; and degraded vegetation and wildlife habitat. LID/GI practices help reduce such impacts and thereby protect the floodplains and associated floodplain resources such as low-gradient streams and wetlands. Furthermore, in cities with combined sanitary/storm sewers, these practices help reduce the number and size of overflow events that result in the discharge of combined and untreated wastewater/stormwater to local receiving waters.

**Examples of some leading LID/GI Practices**

**GREEN ROOF**

**RAIN GARDEN**



**VEGETATED SWALE**

**PERVIOUS PAVEMENT**

# TOLERABLE RISK TO LIFE FROM FLOODS

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What annual risk of flooding and consequent loss of life is tolerable for a particular place? In principle, the 'optimal' risk of economic loss can be approximated from benefit-cost analysis; but risks to life and limb, and risks to the environment are not as easily balanced against investment. A growing international consensus on how to think about risks to life from natural catastrophes raises questions about US flood risk standards. When viewed through the lens of an emerging international consensus on tolerable societal risks, the risks to life from flood and related hazards in the US (*e.g.*, storm surge, dam failure, levee fragility) are highly inconsistent.

**The 100-year (US) flood vs. international practice**

The 100-year flood, that is, the flood with annual probability of 1/100, has become the *de facto* US standard for tolerable flood risk, in large part because of its adoption by the National Flood Insurance Program, and consequently by many cognizant agencies. The 1%-flood is a statistical construct which, in principle, produces a specific flood elevation. In reality, it represents a range of discharge and elevation values that are dependent on the certainty of information available for its computation and the use of probability distributions that portray the range of possibilities that can exist given uncertainties.

The 1% standard was never envisioned as an optimal standard by those who proposed and implemented it. At the time of its establishment, it represented a compromise that could be agreed upon by decision makers and the people who would be affected by its implementation. It would provide a point of departure for adjustments that could reflect the differences that might exist in floodplains across the country and in the objectives of the States and localities that would implement the standard. In practice, it has become much more.

As can be seen from Figure 1, if one presumes that there are perhaps 100 river basins in the US that can generate significant loss of life by flooding, then history suggests that an annual probability of loss of life of 1% is about what we experience in any one basin, with losses in the low hundreds of people being an order of magnitude lower. In contrast, flood standards in many developed countries far exceed the NFIP 1% standard. Japan and the Netherlands use 0.01% (10,000-year) protection for coastal works and 0.5% (200-year) to 0.05% (2,000-year) protection for riverine systems. Being territorially larger, countries such as Germany, Canada, and Australia decentralize development of standards to the State or Provincial level, but the standards typically are still more restrictive than 1%.

**Societal risk**

Some argue that policy with respect to the protection of human life is fundamentally an economic issue, or at least can be approached through economic considerations relative to the value-of-statistical-lives-saved. This view holds that the proper context is economic optimization, and has been adopted by some US Government agencies, *e.g.*, the Environmental Protection Agency.

In many parts of the world, however, an alternative approach has been emerging regarding tolerable risks to loss of life, especially when multiple fatalities are involved. This is sometimes referred to as *societal risk* in contrast to an individual's risk of dying. This approach has been pioneered in the UK by the Health and Safety Executive, but is now common in the Netherlands, Australia, Switzerland, and many other countries; but not the US.

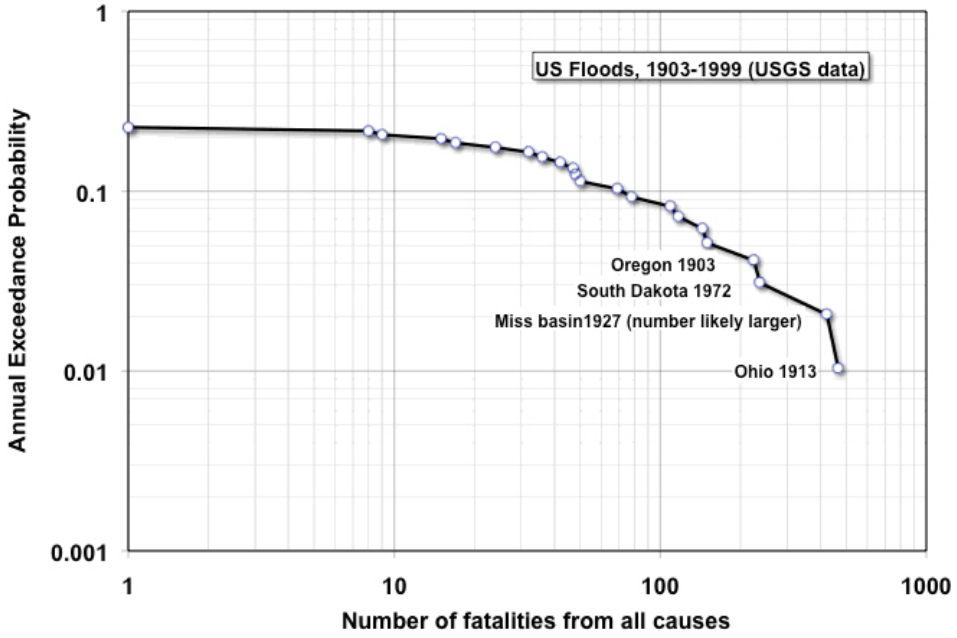


**Figure 3. US fatalities from floods, not including ice-jams, storm-surges, or dam failures (data: USGS, http://ks.water.usgs.gov/pubs/fact-sheets/fs.024-00.html).**

For hazards associated with natural hazards and the built environment societal risk is usually portrayed by *frequency-number* (*F-N*) curves. These plot number of fatalities (*N*) against annual exceedance probability (*F*). In the modern risk analysis literature the F-N curve as a measure of societal risk was popularized by Farmer in the UK with respect to nuclear safety, and was given credence in the US by its use in the 1975 USNRC *Reactor Safety Study* (the Rasmussen Report).

The presumption of this approach is that society appears to accept demonstrable levels of risk in certain daily enterprises, and that these levels should be acceptable in other activities as well. With time society has adjusted to a variety of risks and in doing so has achieved a reasonable balance between risks and benefits. Those risks that people now accept are a guide to what is acceptable for new or changed risks. A number of authors have critiqued these techniques, but they are widely used, and form the basis of public safety regulation in the UK, Australia, and Europe. These criteria commonly identify three levels of risk: those that are "broadly acceptable", those that are "intolerable", and those in between which should be reduced to the extent practicable, the so-called "as low as reasonably practicable" (ALARP) risks. This approach was established in British common law in 1949 by *Edwards vs. the National Coal Board*.

**Conundrum**

The international dam safety community has been moving toward societal risk guidelines which are now widely discussed and to an extent agreed upon. These are typified by the standards

adopted by the Australian-New Zealand Committee on Large Dams (ANCOLD), shown in Figure 2. The US Bureau of Reclamation uses similar standards, and the Corps of Engineers is investigating their use for dam and levee safety.

If, however, one applies such societal risk criteria to the broader enterprise of US flood protection and to protections against other water-related hazards, several orders-of-magnitude inconsistencies can be easily identified in the levels of risk to which the citizenry is exposed. Recent risk analysis studies of New Orleans, the California Delta, the Dutch coastal polders, and elsewhere suggest existing risks to life that are 1000-times higher than those proposed for dam safety. How do we reconcile these existing differences, and do we need to re-think the 1% standard?

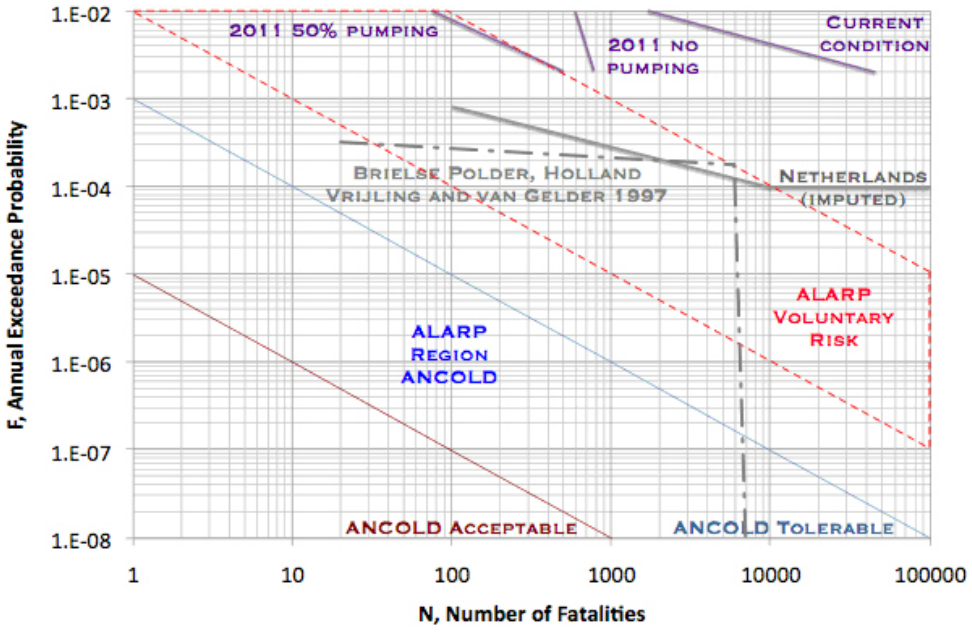


**Figure 4. Comparative risk for NOLA (with various levels of pumping) and the Netherlands, against ANCOLD criteria for existing dams, and including conceptual ALARP zone for voluntary risks.**

Slovic *et al.* have argued that natural hazards are voluntary risks, since people voluntarily choose to live where they do. While certain workers question this view, it is nonetheless the case that people derive benefits from living in river valleys or coastal cities. Voluntarily accepted risks have higher thresholds of tolerability—some argue by 1000-fold—than risks forced upon us. Does this to an extent explain the inconsistencies. Are there other factors or risk perception that influence tolerability of flood risks. Or are we and the citizenry simply misinformed or ignorant of the risk to life that flood protection schemes provide?

# LITIGATION AND MITIGATION—A WAY FORWARD FOR THE FLOODPLAIN MANAGEMENT COMMUNITY

**Edward A. Thomas**
***Michael Baker, Jr., Inc.***

*The following is not, and cannot be, legal advice. It is rather a short statement of general principles of law, and personal opinion. The message is not a privileged communication, does not create an Attorney-Client relationship, and may be freely shared with others.*

## Introduction: Litigation and Discouraging Behavior that Harms Others

There are three ways for a person who suffers damage to be recompensed for damage:

1. **Self-Help.** Rebuilding by the injured party on their own using savings, borrowed money, assistance from National, State and local charities, as well as the help of friends and neighbors. This sort of mechanism was once common in the United States, and survives in many parts of the country as communal efforts for situations such as helping a neighbor rebuild a barn destroyed by lightning.

2. **Insurance**. Casualty insurance can provide an excellent and efficient mechanism for recovery whether the insurance is purchased by the damaged party, or made available through some special legislatively created mechanism. Examples of legislatively established insurance coverage include Workers Compensation Insurance, whereby the State requires employers to pays premiums to make such insurance available to injured workers. The National Flood Insurance Program(NFIP) is another such example. In addition, State and Federal Disaster Relief Grants are a form of special, legislatively established social insurance for disaster victims.

3. **Litigation.** Other than self-help and insurance, litigation is the only other alternative for recovery when a person suffers damage. Successful litigation requires demonstrating that one or more persons, corporations or agencies can be shown to have caused, or somehow been legally culpable for the damage which has taken place.

**Litigation** can both: a) serve as an important mechanism for the recovery of damages; as well as b) encourage safe behavior, which does not harm others. With respect to recovery of damages, litigation is dreadfully inefficient for the following reasons: a) litigation can take many years; b) has huge costs which do not go to the damaged party, but instead go to Attorneys, Courts, expert witnesses, court recorders, and many others; c) is also uncertain, in that the damaged party may not be able to find someone who can be proved to be culpable; d) sometimes our system of justice is not quite perfect: a deserving, damaged plaintiff may not recover from the party which

damaged them due to the ability of "deep pockets" defendants to hire cleverer expert witnesses and/or Attorneys; e) the plaintiff's bad luck; and finally f) an economically or otherwise disadvantaged victim may have difficulty obtaining adequate counsel.

However, from the point of view of encouraging careful "do no harm" behavior, litigation or the threat of litigation can be effective in changing behavior. Such changes have both positive and negative aspects. The positive and negative aspects of litigation relative to preventing harm are the theme of this article.

## Part One: Positive Aspects of Litigation

### A.) Liability for Permitting, or Performing Work Which Floods Others

Dr Jon Kusler, Sam Riley Medlock, and I have written extensively over the past decade on the topic of community and individual liability for carrying out, or even permitting others to carry out activity which floods people. Many of those papers are to be found on the Association of State Floodplain Managers (ASFPM) web-site (http://www.floods.org) under the headings publications, legal papers. In addition, over the past five years, the Michael Baker Engineering company has sponsored over 250 legal lectures, web-casts or other presentations around the nation on topics relative to encouraging communities and individuals who are engaged in development to conduct those activities in a "do no harm" of No Adverse Impact (NAI) manner. Those publications, lectures, and many other activities on the part of many ASFPM volunteers, and staff seem to be having the salutary effect of encouraging a more careful look at development before it causes harm to others.
I suggest that the floodplain management, hazard mitigation and planning communities need to emphasize the rewards of safe municipalities producing less misery and litigation as we try to encourage development activity which does no harm to people, the environment and the taxpayers.

### B.) Liability to Persons Who Legally Were Required to Purchase Flood Insurance But Do Not Have Such Insurance When A Flood Takes Place

As I read the law one of the principal purposes of the National Flood Insurance Program (NFIP) was to create a system where victims of floods would be insured, thus speeding personal and community recovery while at the same time reducing the need for federal and state disaster assistance. To that end the law provides that all persons seeking a mortgage from a federally insured, regulated or supervised institution must be notified if they seeking a loan on a property in an area of the floodplain identified on Federal Emergency Management Agency's (FEMA) NFIP Flood Insurance Rate Maps (FIRM) as a "Special Flood Hazard Area" (SFHA). If they are in an SFHA must be required to purchase and maintain a policy of flood insurance for the life of the mortgage. It has been my experience that when occupants of the SFHA are required to purchase and maintain a flood insurance policy their personal misery is much reduced, the government pays considerably less in disaster relief costs, and community recovery is speeded along. See, e.g., Edward A. Thomas, Stone Soup II, in *Multi-Objective Approaches to Floodplain Management*, ASFPM (1992).

However, when large numbers of people who, by law, were required to purchase and maintain a policy of flood insurance do not have such a policy, one of the fundamental purposes of the NFIP is frustrated, the misery of the disaster survivors is increased, the disaster expenditures government and private charities increases, and community recovery is delayed. As described in Appendix A of this article, at one point it appeared that lenders might be civilly liable for not complying with the mandatory purchase and retention requirements of the NFIP. Unfortunately for disaster victims and their communities, such liability is the exception rather than the rule. However, recently, a federal court indicated that it might be possible to use state consumer protection statue to sue a flood map determination company which allegedly did not correctly ascertain that a flooded homeowner should have been notified that their residence was in a SFHA, and required to purchase a flood insurance policy.

I believe that when the lender, and all others involved with issuing a mortgage make a goof, and the SFHA resident involved is not required to purchase a flood insurance policy, which they desperately need after a flood, to rebuild their lives, some type of redress is needed. That redress could take the form of all involved in the goof paying the flood survivor through an errors and omissions policy, or through civil litigation. In any case this matter can and should be addressed in any consideration of NFIP reform. The possible manner of redressing failure to comply with the NFIP mandatory Purchase and Retention provisions is covered in Attachment A to this article.

### C.) Liability For Not Following a Plan

There is a case in which a city was held liable for failing to follow its Emergency Plan to close off an opening in their levee through which train tracks ran. Their Emergency Plan called for closing the opening, when flood waters were imminent. The city did not close off the opening as flood waters approached, and, therefore, much of the downtown was flooded in the Great Midwest Flood of 1993. The city argued that following their emergency plan was a "discretionary function" of government, and that they were immune under state law for choosing or not choosing to close off this portion of their levee. The Iowa Supreme Court disagreed, and indicated that once a community prepares a plan, they might be liable for failing to execute that plan. *See*, *Keystone Elec. Mfg. Co. v. City of Des Moines*, 586 N.W.2d 340, 343 (Iowa 1998). I wonder if similar logic might be used by courts in reviewing community Hazard Mitigation and Floodplain Management Plans.

### D.) Climate Change Litigation

Litigation concerning climate change has gone from being ridiculed as being a "nuisance" to being considered very seriously by business and industry. Such litigation might well produce reforms in industry activity, land use and permitting. See, e.g., an excellent article, *Courts as Battlefields in Climate Fights,* John Schwartz, New York Times, January 26, 2010.

## Part Two: Aspects of Litigation Which May Discourage Safe Behavior.

Federal Law at 42 USC, Section 1983/1988, provides that persons who allege that they have been injured by public employees "operating under the color of law" may seek damages against those public employees in court. Developers and other landowners have long sought to discourage enforcement of land use restrictions using threats of such suits against regulators. *See*, Edward A. Thomas Esq. and Sam Riley Medlock JD, Mitigating Misery: Land Use and Protection of Property Rights Before the Next Big Flood**,** *Vermont Journal of Environmental Law*, Vol. 9, 2008, p.187. While this section of federal law often produces beneficial results for society, recently it has been used in both Montana and Oklahoma to sue floodplain managers, apparently, for merely doing their jobs of regulating land to prevent harm. *See, e.g.*, *Glen Eagles of Canadian County, L.L.C. v. Bd. of County Comm'rs*, CIV-05-0469-HE, 2006 U.S. Dist. LEXIS 27266, (D. Okla. 2006).

Use of this section of federal law to discourage safe and proper enforcement of floodplain management standards may be a serious threat to our nations' future. For that reason I would suggest that ASFPM:

A.) investigate as to whether or not ASFPM may be able, for future events like this, to make available some sort of professional liability policy for purchase by members which would include a provision of a personal defense;

B.) further investigate what assistance is needed by the floodplain managers involved;

C.) develop a policy and procedure for handling requests for assistance from floodplain managers to assist in resolving such threats.

In my personal opinion, some, but not all of these threats to floodplain managers can be resolved through better No Adverse Impact (NAI) based negotiation techniques, designed to resolve conflict before it escalates like this matter. For that reason, the author, with support from the Michael Baker Corporation; Terri Turner, AICP, CFM the Chair of the Georgia Association of Floodplain Management (GAFM); David Mallory, PE, of the Urban Drainage and Flood Control District (UDFCD) has developed a pilot Negotiations module to help local and state floodplain managers. This Workshop was presented for the first time last year at the GAFM Fall Technical Conference. The workshop is scheduled to be presented again in March of 2010 at both the GAFM Annual Meeting and the Annual Meeting of the Association of Montana Floodplain Managers; as well as at the National conference of the ASFPM in May 2010 in Oklahoma City, Oklahoma.

## Part Three: Conclusion

The Hazard Mitigation and Floodplain Management communities have made effective use of the potential for litigation to encourage safe and proper development and re-development. That positive aspect of litigation needs further use and encouragement. We must also recognize that the threat of litigation may well discourage necessary harm prevention regulation, and therefore take positive steps to avoid such an eventuality.

# Appendix

## Introduction

This brief memorandum is written in response to a question raised by Michael J. Borengasser, CFM, NFIP Coordinator, Arkansas Natural Resources Commission in an e-mail to the Association of State Floodplain Managers (ASFPM). This response is prepared as a *pro bono* effort by Edward A. Thomas Esq. LLC.

The question asked by Mr. Borengasser was:

"I am sure you are aware of the problems homeowners and businesses have with errors in flood zone determinations and disclosures by lending institutions. This seems to be getting worse, and floods here in Arkansas over the past 2 years have brought many inquiries to this office.

I know that Ed Thomas has devoted much time to liability of floodplain managers and developers, but are you aware of cases and studies that focus on lender, insurance agent and zone determination liability? I have read a little on the NFDA website, but I am really concerned about lender liability. Many property owners have been adversely affected by false disclosure statements. There are also many errors in writing flood insurance policies. I am working with FEMA on one community right now where virtually every possible error has been made.

Somehow, lenders, insurance agents and determination companies need to be held liable for their actions.

Of course, there is also variation from state to state.

Please provide whatever information you have."

## I The Disclaimer

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## II Flood Disaster Protection Act

The Flood Disaster Protection Act, at 42 U.S.C.S. § 4104a, states that each federal instrumentality responsible for the supervision, approval, regulation, or insuring of banks, savings and loan associations, or similar institutions shall by regulation require such institutions, as a condition of making, increasing, extending, or renewing any loan secured by improved real estate or a mobile home located or to be located in an area that has been identified by the secretary under § 4104a chapter as an area having special flood hazards, to notify the purchaser or lessee (or obtain satisfactory assurances that the seller or lessor has notified the purchaser or lessee) of such special flood hazards, in writing, a reasonable period in advance of the signing of the purchase agreement, lease, or other documents involved in the transaction.

## III Duty of A Lender

For years the lender associations, and for that matter the federal instrumentalities who are responsible for supervising the lenders, indicated that they felt that the borrower (consumer) were not within the scope of those who were being protected by 42 U.S.C.S. § 4104a. They argued that the lenders were the ones being protected by the notification and mandatory purchase

requirements. This interpretation of the law almost universally prevailed in court. In fact lenders and map reading firms won in court, on this issue, so far as I my research has found, almost without exception until: Small v. South Norwalk Savings Bank, 205 Conn. 751 (Conn. 1988). In that case, the borrower was not notified that they were in a flood zone, did not purchase flood insurance, was flooded and sued the lender successfully. Those of us who did lender workshops rejoiced and flogged the results of the case mercilessly. The case went to the Connecticut Supreme Court and that court upheld the lower court ruling on very narrow technical civil procedural grounds.

Dolorously, from my personal perspective anyway, later Connecticut cases such as McKiernan v. Green, 2005 Conn. Super. LEXIS 1527, 6-9 (Conn. Super. Ct. June 10, 2005), reached very different results. Those cases basically indicated that with respect to lender liability, 42 U.S.C.S. § 4104a, exists to protect the lender not the borrower. Such reasoning was generally followed around the country in cases such as: a) Lukosus v. First Tenn. Bank National Association, 2003 U.S. Dist. LEXIS 11941 (W.D. Va. July 9, 2003); b) Callahan v. Country Wide Home Loans, Inc., 2006 U.S. Dist. LEXIS 51217 (N.D. Fla. July 26, 2006); and c) Bigler v. Centerbank Mortgage Co., 1994 Conn. Super. LEXIS 3214 (Conn. Super. Ct. Dec. 12, 1994).

With respect to lender liability for erroneous flood determinations a federal district court recently stated what appears to be the current state of the law concisely:

"The courts have consistently held that the NFIA does not create a private cause of action for alleged inaccurate flood determinations. See, e.g., Wentwood Woodside I, LP v. GMAC Commercial Morg. Corp., 419 F.3d 310, 323 (5th Cir. 2005). In Till v. Unifirst Fed. Sav. & Loan Ass'n, 653 F.2d 152, 159-60 (5th Cir. 1981), the plaintiffs filed suit against their mortgage lender and its subsidiary based on the defendants' failure to notify them that their home was located within a Special Flood Hazard Area and their consequent failure to require flood insurance. Till, 653 F. 2d at 154-55. The district court held that the NFIA did not create a private cause of action. Id. at 156. The Court of Appeals affirmed, holding that the NFIA "merely require[s] lending institutions to notify borrowers of flood plains and require flood insurance." Id. at 158. In concluding that no private right of action existed under the NFIA, [*6] the Fifth Circuit determined that the plaintiffs were not the "primary beneficiaries" of the Act: In short, [plaintiffs] are not the especial beneficiaries of [the NFIA] in view of the fact that the only duties imposed therein are upon the various federal regulatory agencies and the clear indication of concern not merely for the borrowers but also for the federally insured lending institutions. … Our examination of legislative history reveals no evidence of specific congressional intent to vest [plaintiffs] with any federal right to damages for a violation of [the NFIA]. Instead, the only discernible evidence of intent suggests no such private remedy was envisioned." *See*, *Kelly v. Wash. Mut., 2009 U.S. Dist. LEXIS 63683, 5-6 (S.D. Miss. Apr. 28, 2009*.(highlighted emphasis added).

## IV Duty of a Map Determination Company

Although for over thirty years lenders and the companies who read FEMA Flood Insurance Maps had almost universally escaped legal liability when they read a flood map incorrectly, in the US Court of Appeals case of: Paul v. Landsafe Flood Determination, Inc., No. 07-60652 (5th Cir. Dec. 5, 2008), the court allowed a plaintiff to use state consumer protection law to attempt to show negligence on the part of the lender' map determination company; not the lender. The court noted that a Flood Zone Determination was the "kind of professional opinion for which it is foreseeable that justifiable and detrimental reliance by a reasonable person would be induced.

This logic was followed recently in the case: *Kelly v. Wash. Mut.*, 2009 U.S. Dist. LEXIS 63683 (S.D. Miss. Apr. 28, 2009) where the court stated:

"In the present case, a third party, not WaMu, performed the flood zone determination for the Kelly property. This fact distinguishes the present case from the holding set forth in Paul v. Landsafe Flood Determination. v. Landsafe Flood Determination. Based upon the facts of this case, the Court is of the opinion that Plaintiff has not carried the burden of demonstrating the existence of any legal duty owed her by WaMu under state law. The Court must therefore conclude that Plaintiff is unable to state a claim against WaMu under Mississippi law."

So, it appears to me that while lenders may escape liability for erroneous map determinations, there is at least some possibility that under some state laws, most likely consumer protection statutes and the like, map determination companies may sometimes be subject to a law suit for erroneous flood map determinations.

## V Other Lender Impacts

To my personal knowledge there have been other times when lenders have been held accountable, not through the courts but in other ways:

### A. Friendly Persuasion

In at least some cases lenders have used bank funds to recompense flooded borrowers who were not properly notified and required to purchase flood insurance when the flood maps clearly showed the residence in the SFHA. Typically the lenders did this to avoid negative publicity and possible reporting to regulatory authorities.

### B. Regulatory Oversight

At least some of the federal regulators have reported fines against lenders for patterns of non compliance with 42 U.S.C.S. § 4104a.

### C. FEMA Assistance in Regulatory Oversight

To assist the regulators in their oversight FEMA at one time had an informal policy of encouraging regions to perform post flood disaster audits of compliance with 42 U.S.C.S. § 4104a. Those audits produced a huge wave of compliance. In my personal opinion, the results produced by those audits were a significant reason that, when FEMA and the State did their damage estimates following Hurricane Bob in New England (Bob struck Massachusetts, Rhode Island, and New Hampshire in 1991) they found an astonishing 85% of the homes afflicted by Bob's flooding were covered by flood insurance. **There was therefore, no need to turn on the costly Individual Assistance Grant programs for that disaster. Thus, the consumer and the federal government saved enormous amounts of money and hardship**

## VI Duty of a Seller of Property

Sellers of property who fail to disclose that the property has defects, for example that it is flood prone, may have a state imposed duty to disclose those defects. Sellers who hide those defects may even be liable for perpetrating a fraud. A good illustration of this is the Connecticut case of:

*McKiernan v. Green*, 2005 Conn. Super. LEXIS 1527, 6-9 (Conn. Super. Ct. June 10, 2005). In that case, the court concluded "that the defendants breached their contract with the plaintiffs by failing to fairly disclose the flooding potential of the river in the residential disclosure documents and in answers to questions posed by the buyers in the discussions leading up to the plaintiffs' purchase." The court imposed damages of over $100,000.

## VII Duty of a Real Estate Agent

In most situations, the primary duty of a real estate agent is usually to their client, the seller. However, generally speaking, under state law, the agent cannot participate in deliberate false representation to the purchaser. In the case of *McKiernan v. Green*, 2005 Conn. Super. LEXIS 1527, 6-9 (Conn. Super. Ct. June 10, 2005), cited above the court looked at the facts of the situation and determined that the realtor was not shown to have knowledge of the false statements about flooding made by the seller. The real estate agent therefore escaped liability to the buyer.

# CLIMATE CHANGE: A RISK TO PEOPLE, INFRASTRUCTURE & THE NATURAL ENVIRONMENT

**Kristen Fletcher and Julia Wyman**
***Coastal States Organization***

Climate change is one of the greatest risks that our nation faces, to both humans and floodplain resources. The challenges and burdens presented in the era of climate change are most acute in the coastal states. Climate change incorporates many different environmental changes, including: sea level rise, lake level changes, increased storm intensity and frequency, erosion, invasive species, increased rainfall and related flooding, ocean acidification, saltwater intrusion into groundwater aquifers, increased harmful algal blooms, spread of invasive species, habitat loss (especially coastal wetlands), species migrations, and changes in population dynamics among marine and coastal species. Coping with these changes and adapting to climate change is one of the most significant challenges and opportunities that coastal states are now facing. The Coastal States Organization (CSO) recognizes that climate change will have far-reaching impacts on the coastal states in relationship to human health, the built environment, and the natural environment.

CSO was established in 1970 to represent the Governors of the nation's 35 coastal states, commonwealths and territories regarding legislative and policy issues relating to the sound management of coastal, Great Lakes and ocean resources. CSO supports the shared vision of the coastal states, commonwealths and territories for the protection, conservation, responsible use and sustainable economic development of the nation's coastal, ocean and Great Lakes resources. For the last few years, climate change has been one of CSO's primary areas of focus. While each coastal state faces different challenges with climate change, all coastal states are experiencing changes in their natural environments and many are preparing for the future by adapting their policies and laws to better reflect their changing coastlines. To best protect their inhabitants, public structures, and natural resources and beauty, states must plan today to adapt tomorrow.

One of the first steps for states to successfully adapt to climate change is for states to properly measure and qualify risk within their jurisdictions. For many states, assessments have already been conducted on the county level. Gathering this existing county-level data and making it accessible statewide is essential to effective climate change adaptation. With limited state funding, gathering existing data that can be re-examined with an eye to climate change adaptation, will be extremely beneficial to avoid duplicative work. Once county data has been assessed and combined, statewide assessments can be properly conducted. This will be beneficial for individual state planning as well as regional planning. The environmental problems the coastal states are facing know no jurisdictional boundaries; as governor-created regional ocean partnerships develop and combat issues of climate change and ocean and coastal development, the existence of statewide assessments and data will be crucial in developing and supporting regional cooperation.

To properly plan for climate change on both the state and regional level, states need access to federal resources including information, technical assistance and funding. An acute need is for federal guidance on the standards for gathering data, such as LiDAR and bathymetric data. LiDAR and bathymetric data will be essential for mapping the current coasts and the future coasts; this will allow for proper zoning regulations and changes, planning for future roadways, sanitation, and possible relocation of key public infrastructure. Gathering this data is the first key to the proper development of adaptation plans.

CSO hopes to discuss at the Gilbert F. White National Flood Policy Forum some of the challenges facing the states in gathering the appropriate information for climate change adaptation in the coastal states, as well as brainstorm on future collaborations and partnerships with state and federal government, non-profits, and the private sector on how to best cope with the challenges that face all of these groups.

# MAINTAINING AND EXPANDING BASIC DATA IS CRITICAL TO FLOOD RISK MANAGEMENT

## Matthew B. Miller

Floodplain mapping is a cornerstone of flood risk and floodplain management. Creating reliable risk information depends on basic data that define the earth's surface and its meteorological processes. Without these data sets it is not possible to accurately model probable future flooding. It also makes the successful design of water-related infrastructure more difficult and less dependable. Lastly, much of this information is necessary to track and model the effects of climate change on flooding, rainfall distribution, and shoreline change. These data include or are developed from:

- Rainfall gauging stations,
- Stream flow gauging stations,
- Coastal elevation gauging stations (tide gauges),
- Topographic (elevation) data,
- Base Maps showing the location of natural and manmade landforms, and
- Geodetic data that provide a reference system locating the above data in the horizontal and vertical relative to each other, e.g. benchmarks.

Some of these basic data cannot be created on an as-needed basis, but must be developed over many years; rainfall, stream flow, and coastal water surface elevation data are examples of these. Because of short-term variability, an adequate historical record is needed to capture normal and extreme values. A continuing historical record is also important to track long-term trends; for example, sea level rise and shoreline change. Unfortunately, funding these activities on a consistent and long-term basis is too frequently neglected. Therefore, when decision makers or other users require critical analyses, the data may not exist to provide reliable answers. This background paper will summarize what entities are responsible for producing the data, and why these entities and their data are important and deserving of sustained, public support.

**Basic Data Sets: Uses and Importance**

**Rainfall gauging stations** are located throughout the Nation and record the amount and duration of rainfall (for example, total rainfall in inches and rainfall intensity in inches per hour). The National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS) administers this network of gauges. They have many uses, but for floodplain mapping purposes, the most important are the precipitation depth-duration-frequency maps available at: http://www.nws.noaa.gov/ohd/hdsc/currentpf.htm. These maps are used to develop detailed rainfall-runoff (hydrologic) models that calculate flood discharges for a stream. (A flood discharge is a critical component of a riverine flood study.) When adequate rainfall information is not available, other hydrologic methods must be used that may not yield as good a result.

Information developed from the network of rainfall gauges has many other valuable applications beyond flood studies. These include real-time flood forecasting, community water supply studies, design of flood control works, and transportation infrastructure. [1]

**Stream flow gauging stations** are located on major streams throughout the Nation and record stream flow information at the location of the gauge. Stream flow information creates a record of the volume of water carried by a stream or river. When stream flow information has been collected for a sufficient period of time (ten years is a minimum for FEMA flood insurance studies)[2], the flood discharge and flood elevation at the gauge site can be computed. This information is critical for developing an accurate hydrologic and hydraulic model for a stream. (A hydrologic model computes a flood discharge, or how much water is flowing. A hydraulic model is used to calculate the flood elevation for a given flood discharge along a stream, e.g., the 100-year flood discharge from a hydrologic model is used in the hydraulic model to compute a 100-year flood elevation (base flood elevation or BFE)).

The Department of the Interior's U.S. Geological Survey (USGS) administers the network of stream flow gauges.[3] These gauges are also critical for flood forecasting, design of flood control works, and transportation infrastructure.

**Coastal elevation gauging stations (tide gauges)** are located along the coastal waters and Great Lakes of the United States. They record daily tidal fluctuations and the elevations associated with flooding events. In addition, tide gauges are used to calibrate coastal flooding models. The data from tide gauges are also critical for marine navigation and design of coastal infrastructure. NOAA administers the network of gauges.[4]

**Topographic (elevation) data** are used in the development of the hydrologic and hydraulic models for flood studies, and the information is also essential for delineating flood boundaries. The more detailed and accurate the information is, the more detailed and accurate the delineation of the flood boundary is. The USGS has been the federal agency with the responsibility for mapping the Nation for over 130 years, and while its focus has shifted from developing data to organizing it and making it available for public use, it plays a critical role in providing mapping for the U.S.[5]

"The National Elevation Dataset (NED) is the primary elevation data product of the USGS. The NED is a seamless dataset with the best available … elevation data of the conterminous United States, Alaska, Hawaii, and territorial islands. The NED is updated on a nominal two-month cycle to integrate newly available, improved elevation source data. All NED data are public domain."[6] The elevation data maintained by the USGS are not detailed or comprehensive enough to fulfill all of the requirements of floodplain mapping. Underwater stream channel information, bridge geometry, and detailed floodplain elevations are not contained in the NED and are generally developed at the time a flood study is prepared. Nonetheless, the elevation data maintained by the USGS are critical for the Nation's floodplain mapping efforts.

**Base maps** are used to present the results of a flood study and generally show the location of natural and manmade landforms, such as roads, streams, shorelines, and political boundaries. This type of information is called "planimetric data" and represents only the horizontal position of features on the earth's surface. It is generally compiled into map features through photogrammetric or surveying procedures.

USGS 7″ minute quadrangles and Digital Orthophoto Quadrangles are the primary base maps used by FEMA in the preparation of Flood Insurance Rate Maps.[7]

**Geodetic data** provide a system to locate the above-described base data relative to each other; that is, it establishes a three-dimensional reference system to relate features on the earth to each other horizontally and vertically. The vertical and horizontal reference system used for each component of a flood study must be consistent with the other components. The physical representation of this geodetic reference system is benchmarks. For floodplain management purposes, benchmarks are used to ensure that new construction is built above flood level, and to determine the relative elevation of existing construction to flood level for flood insurance rating purposes. Geodetic data are widely used everyday for surveying, construction, and navigation (GPS for example).

"NOAA's National Geodetic Survey (NGS) defines and manages a national coordinate system. This network, the National Spatial Reference System (NSRS), provides the foundation for transportation and communication, mapping and charting, and a multitude of scientific and engineering applications."[8]

**Incomplete Data for Monitoring Climate Change**

An important issue facing the Nation is the long-term change in our coastlines resulting primarily from sea level rise.[9] While the NGS [10] and the USGS [11] have made strong efforts in identifying and disseminating existing studies and data, a more holistic approach needs to be undertaken. For instance, a planimetric and topographic survey of all the coastlines of the U.S. on a five-year cycle would be more than adequate (and invaluable) in establishing a baseline and database for evaluating long-term coastal erosion and certain aspects of sea level rise.[12]

**Conclusions**

Our ability to estimate and mitigate flood risk is only as good as the data allow. Both the span and consistency of the data are critical. Some of the data sets (in particular rainfall, stream flow, tidal, and shoreline location), while of immense value now and in the short-term, may take years to develop before they become of value in estimating certain types of long-term risk. Accordingly their value decreases significantly when the record stops or is interrupted. Importantly, these data sets are the tools we use to "sense the earth." They are the tools our children will need to understand the earth they inherit in a time of rapid climate change. These data need to be developed, improved upon, and maintained.

**References and Background Information**

For an overall summary of the National Flood Insurance Program and its flood hazard mapping program, see "Improving FEMA's Coastal Risk Assessment through the National Flood Insurance Program: An Historical Overview", by Mark Crowell, Emily Hirsch, and Tom L. Hayes, *Marine Technology Society Journal*, Spring 2007, Volume 41, Number 1, available at http://mysite.verizon.net/markcrowell/pdf-Crowell%20Hirsch%20Hayes.pdf, (accessed on 01.30.2010).

## Endnotes


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# WHAT IS Risk MAP?

**Doug Bellomo**
***Federal Emergency Management Agency***

Risk Mapping, Assessment, and Planning (Risk MAP) is a new FEMA program that builds on the strength of Map Modernization to help communities nationwide with risk assessment and mitigation planning. The program combines quality engineering with updated flood hazard data to help communities plan for and prevent risk using the best possible information. Proper planning translates into many more lives and dollars saved.

The handout on the next two pages explains the content, procedures, and benefits of Risk MAP.

FEMA

# What is Risk MAP?

## The Risk MAP Team

**FEMA's ten regional offices** implement the Risk MAP program at the local level through coordination with partners, community officials, and the general public.

**FEMA Headquarters** provide direction, policy and uniform guidance to ensure the program is consistent across the nation and successful.

**Local, regional and state communities** ensure updated hazard data is used to make informed decisions regarding risk.

FEMA provide general oversight for Risk MAP, help integrate activities, design and implement a nationwide outreach strategy, and foster partnerships with key FEMA stakeholders.

## FEMA's Risk MAP Multi-Year Plan

On March 16, 2009, the U.S. Congress approved FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) Multi-Year Plan: Fiscal Years 2010-2014.

This document outlines the goals, objectives, and strategies for Risk MAP and summarizes FEMA's strategic planning approach and stakeholder roles and responsibilities. For a digital copy, visit www.fema.gov/plan/prevent/fhm

**Risk Mapping, Assessment, and Planning (Risk MAP)** is a new FEMA program that builds on the strength of Map Modernization to help communities nationwide with risk assessment and mitigation planning. The program combines quality engineering with updated flood hazard data to help communities plan for and prevent risk using the best possible information. Proper planning translates into many more lives and dollars saved.

## The Risk MAP Vision

Through collaboration with State, Local, and Tribal entities, Risk MAP will focus on products and services beyond the traditional Digital Flood Insurance Rate Map (DFIRM) primarily used to set flood insurance rates and communicate one percent chance flood risk. FEMA will advise officials on how to effectively communicate risk to citizens and create corresponding mitigation plans that work. Relying on disaster recovery and assistance is not the answer.

## Risk MAP Solution

New strategies are incorporated into the Risk MAP Solution that will be integrated across Risk MAP products to achieve the program's vision.

## Risk Assessment

- Establishes foundation baseline for creating, managing, and maintaining assessment data
- Conducted using a watershed approach
- Based on mapping needs and risk
- Encourages proactive assessment, planning, and mitigation action through program incentives


## Mitigation Planning

- Couples mapping and assessment in a watershed jurisdiction
- Develops methods to assess mitigation planning
- Fosters stakeholder engagement in the project lifecycle to communicate Risk MAP project benefits to planning officials
- Encourages community interaction during project lifecycle

## Risk Communications

- Enables tailored outreach with communications plans, templates, and materials
- Facilitates national and local collaboration through key partnerships

**Vision**
Risk MAP will deliver quality data that increases public awareness and leads to action that reduces risk to life and property

| Multi-Year Plan | | Risk MAP Program Measures | | |
|---|---|---|---|---|
| **Goal 1: Data Gaps** | **Goal 2: Awareness & Understanding** | **Goal 3: Mitigation Planning** | **Goal 4: Digital Platform** | **Goal 5: Synergize Programs** |
| Address gaps in flood hazard data | Measurably increase public's awareness & understanding | Lead effective engagement in Mitigation Planning | Provide an enhanced digital platform | Align Risk Analysis programs and develop synergies |

**http://www.fema.gov/plan/prevent/fhm/ ■ 1-877-FEMA MAP**

- Determines appropriate size and scale of needed communications through integration into project-level meetings
- Creates compelling risk communications through customizable data, tools, incentives, and messaging
- Measures effectiveness of risk communications through national surveys


## How?

Communications will be developed at a national level but tailored at a local level to address the unique needs of communities. They will be distributed through media and local meetings to key stakeholders. Messages have been developed for stakeholders such as floodplain managers and state and local officials.

## Annual Scheduling Approach

- Project prioritization at a watershed level based on risk, need, and elevation data
- Enables continuous improvement by helping create:
  - CNMS Level 1 and Level 2 products
  - Annualized Loss Estimate Study
  - National Elevation Data Inventory
  - Final Funding Guidance to Regions for FY10
  - Risk-Need Community Contribution Algorithm for FY11 Sequencing

## Watershed

- Encourages work across community boundaries and consideration of impact on surrounding communities
- Increases FEMA's ability to collaborate with other federal agencies that already use the watershed approach
- Improves usability and overall data value by setting the stage for new analyses
- Allows for better depiction of flood hazards, known to follow streams within watersheds
- Enables FEMA to better identify the need for study efforts

## Elevation Data Acquisition

- Leverage available data and acquire limited new data
- Identify existing value-added sources of data and announce that FEMA seeks to cost share for high-quality data
- Permit data acquisition as separate element of work
- Acquire on watershed basis taking into account economies of scale

## Engineering and Mapping

- Will enable flexible and customizable mapping products and processes required to serve unique community risk needs.
- Will be conducted on a watershed level to align with the natural floodplain and risk boundaries and to increase visibility of the FEMA data inventory.

| | Map Mod | 2010 and Beyond |
|---|---|---|
| Risk Assessment | Credibility of Risk Assessment data at local level unknown | • Initiate risk baseline for nation<br>• Create, manage and maintain assessment data |
| Mitigation Planning | On a project by project basis | • Provide many technical support options on a national level<br>• Expand community interaction<br>• Provide project-level inputs including flood "root-cause" analysis, a "Risk MAP", refined flood risk assessments |
| Risk Communication | Centered on crucial risks | • Enhance relationships with officials and other stakeholders about long-term mitigation before problems arise. Everyone is at flood risk |
| Annual Scheduling Approach | Based on Risk | • Annualized loss study (Trifecta)<br>Risk x Need x Good Topo + Community contribution |
| Elevation Data Acquisition | Best available data | • Cost-sharing for new quality elevation data |
| Engineering & Mapping | County by county basis (detailed and approximate) | • Watershed approach (greater variety catered to community needs)<br>• Meet all coastal and levee commitments<br>• All Model-Based analysis |

http://www.fema.gov/plan/prevent/fhm/ ■ 1-877-FEMA MAP

# Part 5

# National Policy and Programs—
# Ideas and Suggestions for Change

# UNDERSTANDING FLOOD RISK TO FOSTER SHARED RESPONSIBILITY IN FLOOD RISK MANAGEMENT

**Peter D. Rabbon**
***National Flood Risk Management Program***
***U.S. Army Corps of Engineers***

"Shared responsibility" has become a guiding concept for the U.S. Army Corps of Engineers (USACE) as the agency recognizes that the success of its own flood risk management programs is inextricably tied to the land use and floodplain management choices made by state and local government as well as private citizens. Fostering shared responsibility requires broadening our current understanding of flood risk to include consideration of the economic, social, cultural and behavioral factors that drive flood risk through their influence on individual and community choices in how to use flood prone lands and whether to adopt flood risk mitigation measures.

The concept of "shared responsibility", as described by MG Don Riley while serving as the USACE Director of Civil Works, emphasized the importance of empowering communities and citizens to engage in risk-informed decision making to actively manage their own flood risk. MG Riley suggested that successful management of flood risk requires utilizing a broad range of tools that enable citizens to lower or "buy down" their flood risk, including zoning ordinances, evacuation planning and public outreach. Such mechanisms for "buying down" risk are provided through numerous different agencies at the State, Federal and local level, as well as from the private sector. The choice to utilize such tools likewise involves all stakeholders.

To foster shared responsibility in managing flood risks, USACE strives to carry out its own programs in careful coordination with other Federal agencies and counterpart programs at non Federal levels of government to best support local flood risk management efforts. In May 2006, the agency established the National Flood Risk Management Program (NFRMP) to take the first step of bringing together other federal agencies, state and local governments and agencies, and the private sector with stakes in flood risk management.

Seeking ways to implement USACE programs to better support shared responsibility, requires understanding flood risk in the context of the economic, social, behavioral and cultural factors driving individual and community choices that contribute to or mitigate risk. To meet this need, through the a study conducted out of the USACE Institute for Water Resources, USACE is working to identify, examine and, where possible, quantify factors that influence individuals' and communities' perceived risks and rewards when making choices that influence flood risk. Such factors include:

1) the range of perceived fiscal, environmental, social or other benefits arising from land use choice or behaviors that have the effect of increasing flood risks,
2) the perceived costs of adopting risk mitigation measures or behaviors,
3) risk attitudes and perceptions of the likelihood and consequences of flooding
4) cultural, behavioral and psychological features that influence how messages on flood risk are "heard" by the intended recipients,
5) the quantity, quality and accessibility of information regarding risk, and

6) the combination of Federal, state and local laws, policies and regulations in effect that influence the perceived risk or rewards from flood plain location or flood risk mitigation actions.

A large part of what we need to know about flood risk in order to function in a "shared responsibility" context is why choices are made that put people at risk – or, similarly, why choices are made to not pursue actions that would mitigate risk. Insights into factors driving the perceived risk-reward equation that underlies personal and community choices contributing to or mitigating risk provides USACE and its partner agencies a basis for improving risk communication by helping to identify what types of information will be most relevant and useful to facilitate community and individual flood risk management choices. Additionally, this knowledge provides a basis for understanding how USACE flood risk management programs and policies work, in conjunction with other Federal and non Federal policy to affect land use and flood risk mitigation choices.

Understanding the Federal role in managing the nation's flood risks within the context of "shared responsibility" requires first understanding non-Federal needs and perspectives. Expanding our examination of flood risk beyond the traditional focus on hydrologic and hydraulic analyses, engineering studies and structure inventories, to explore the range of factors that influence the individual and community choices playing a central role in determining flood risk, will help USACE and its Federal agency partners better explore what roles they can play in supporting shared responsibility in the management of the nation's flood risks.

# FLOOD INSURANCE FOR RISK COMMUNICATION: RECLAIMING ORIGINAL INTENT

**Leonard Shabman**
***Resources for the Future***

A 1960s a report prepared under the leadership of Gilbert White was an essential reference to the designers of the National Flood Insurance Program (NFIP) (A Unified National Program For Managing Flood Losses, 1966, House Document 465). The report argued that landowners deciding to locate an activity on a flood plain (or in coastal hazard area) must be *informed* about the risk taken and must be *responsible* for future property damages incurred at the location or imposed on others and the environment. "Use of floodplains involving periodic damages is not, in itself, a sign of unwarranted or inefficient development. It may well be that the advantages of flood plain location outweigh the intermittent cost of damage from floods". (HD465, p. 13) The report goes on, "Flood damages are a direct consequence of flood plain investment actions, both private and public. Floods are acts of God; flood damages result from the acts of men. Those who occupy the flood plain should be responsible for the results of their actions." (HD465, p. 14)

What was understood then, and is still a concern today, is whether individuals and businesses can readily understand their exposure and vulnerability to flood hazard from rarely experienced storm events. Today this concern is manifested in the increased attention to improving risk communication. However, reflection on the original intent of the NFIP reminds us that bearing the costs of flood plain location choices is a practical and effective way to inform landowners of flood risk, as well as replacing taxpayer costs of post-disaster relief with insurance payouts.

Over time and for a variety of different reasons the NFIP as implemented is not seen as a risk communication tool. Instead flood insurance is often described as one of a methods for post flood relief and as a substitute for disaster aid -- even though a properly design insurance program is primarily about correct ***pre-flood*** location incentives and secondarily about ***post-flood*** loss relief. The result of a misplaced focus is that the NFIP today makes too few flood-plain occupants informed or cost responsible. The facts are well known. Less than 25 percent of individual homes and businesses in areas that will experience at least one significant flood over a 30-year period actually purchase flood insurance. There have been many efforts to increase purchase, but only with limited effect. Of equal importance, insurance purchase requirements only apply to that portion of the flood plain where the chance of a flood is 1 percent in any year (a so-called 100-year flood), ignoring floods that would be less frequent, but of possibly greater potential damage.

Expecting properties located throughout the whole flood plain to have insurance with premiums commensurate with flood risk remains an attractive objective for a national flood-risk management policy. An innovative way to achieve this is for the NFIP to offer group flood insurance policies for all at-risk properties in the community. These policies would be purchased by local governments or specially designated flood-risk management districts. The costs could be recovered through special assessments levied on each covered property, as an adjunct to the regular property tax assessments. Premiums would vary with location on the flood plain and the

assessed value of improvements on the property. Offering flood insurance coverage through landowner assessments is simply building on the well-established practice of non federal governments taking fiscal responsibility for flood risk mitigation; for example, levee districts across the nation collect taxes for the construction, repair and maintenance. In a paper after the 1993 floods I proposed such a program. Little has changed since 1993 and the general idea remains attractive.

Several reform actions must be taken to make this proposal practical and attractive to local governments and their citizens. First, Congress should authorize the NFIP to develop and offer a new form of insurance – a community (group) policy – but only if the policy covers all properties within and outside of the FEMA base flood plain. The group premium cost for the community would be set by the NFIP. That rate structure would be refined over time but could build from the current rate setting procedures for individual properties. This approach would increase the number of policies in effect and therefore expand market penetration (increase in the pool of insured properties), spread risk, and lower premium costs. Properly designed, it should also reduce administrative costs for individual coverage and claim filing, further lowering premiums.

Second, Congress should create a catastrophic-disaster aid trust fund with payments from that fund reserved for storms meeting clear, predetermined criteria. The fund would be financed by an annual on-budget allocation of general revenues and with annual fees paid by localities purchasing group insurance. If damages exceed insurance coverage (after considering deductibles) payment would be made from the catastrophic fund to the individuals in communities that were covered by the group insurance. Those communities that could have implemented a group insurance program and paid into the catastrophic trust fund, but chose to not do so, would not be eligible for payments from this fund. Instead they would continue to have access to the uncertain, not very generous and red-tape bound "off-budget" disaster aid programs that now exist. Recognition of this program reality might encourage local jurisdictions to make group purchases and participate in the catastrophic loss fund. An added benefit of this approach is that group insurance premiums could then set for the less extreme events, lowering premiums for local communities to more attractive levels.

Third, the Congress should direct the NFIP to develop this program over time in consultation with and with advice from the private insurance industry. If group policy purchase proves attractive, private insurers might enter the market as an alternative to the NFIP group plan. Today, localities can purchase private all risk, including flood, insurance for local infrastructure. Private offerings of group flood to homes and business insurance might be offered by private sellers as an extension of those local infrastructure policies. Indeed, the 1960s arguments as to why private insurers could not offer this product (forms to small, could not spread risk into capital markets) may no longer hold. The best way to determine this is to assure that the NFIP group program design accommodates and encourages private insurers to enter this market.

Fourth, the federal government should help finance the group premium of communities that purchase insurance either from the NFIP or private companies. This cost sharing could vary with the degree of community effort to reduce exposure or vulnerability, much as is now done through the community rating system under the existing NFIP. Cost sharing may be tied to the expense of providing coverage for pre-existing structures or might offset high insurance costs for low-income people located in flood-prone areas. To be sure, while actuarial soundness is a long term

goal – in the interim risk communication can be achieved by ANY level of group premium, as long as every at risk property is assessed for a share of the group premium cost.

Fifth, the federal government has struggled for decades to define and execute a national flood risk management policy and as a result, there are myriad federal flood risk management programs. With modest modifications, these could be re-designed to become incentives for local community purchase of group policies. As one example, funding priorities for flood hazard reduction projects might favor communities that purchase and maintain a group policy. As another example, special funding for FEMA flood risk mitigation grants might be made available for communities that purchase community policies when the funds used by the localities remove those properties that add most significantly to the group premium.

**Conclusion**

Community flood insurance is an opportunity to reclaim the intent of flood insurance as a risk communication tool. One challenge is designing policies that will motivate communities to purchase such insurance. A second challenge, not discussed above, is anticipating and then addressing citizen reactions to "mandatory insurance purchase". Providing and then charging for flood protection works based on predicted enhancement of land value still was occasionally resisted by some benefiting landowners. Based on that experience special assessments for flood insurance certainly would be resisted by some. There are a number of strategies that can be imagined for overcoming such resistance, and these will need to be built into the program design. What is needed now is to renew the original intent of the NFIP program as a policy approach to risk communication and cost responsibility.

# HAZARD MITIGATION PLANNING VERSION 3.0

**Chad Berginnis**
***Michael Baker Jr., Inc***

Mitigation planning has officially entered into its second iteration as tracked by the number of planning/update cycles in which local communities have participated. After the passage of the Disaster Mitigation Act of 2000, local mitigation planning began in earnest circa 2003 as guidance materials and resources became available. Arguably the single largest national planning effort since the late 1960's comprehensive planning effort through HUD, hazard mitigation planning resulted in over 15,000 communities participating in the planning process from 2002-2008. Currently, we are in the middle of the first required five year mitigation plan revision for most communities nationwide. From this vantage point we can evaluate strengths and weaknesses of the first iteration, make some reasonable conclusions about the second iteration and determine what is needed in the third iteration to achieve a vision of more disaster resilient communities and the integration of hazard mitigation into all community operations.

**First Iteration**

The first mitigation plans were a learning effort in every sense of the term. FEMA, states, and communities all struggled with the new planning concepts that were introduced as part of DMA 2000, and subsequently written into rule. What constitutes an adequate risk assessment? How should flood maps and flood hazard data be incorporated efficiently into mitigation plans? What are appropriate mitigation strategies and what is the range of mitigation strategies possible? The most significant outcomes of the first iteration include:

- Increasing understanding of the term "mitigation." Up until the planning efforts, hazard mitigation was largely the purview of the local emergency management agency, hazard practitioner, and communities proactively engaged in hazard risk reduction.
- Community familiarity with mitigation options that exist.
- Community familiarity with the hazard mitigation planning process.

As would be expected, there have been some lessons learned as well. Mitigation plans in the first iteration:

- Often confused mitigation with other elements of emergency management – especially preparedness and response functions. This is likely due to the fact that the majority of the mitigation plans developed were led by local emergency management agencies who have these other responsibilities as well.
- Usually contained far too many action items identified and far too few actions accomplished. The mitigation strategies in these plans have been largely unrealized with few actions accomplished and very little compliance with annual monitoring and evaluation programs identified in the plans.
- Tended to focus too much on the Risk Assessment and not enough on the Mitigation Strategy. Many plans contained large, complex risk assessments that were little understood by community officials (and in a format that would have been exceedingly difficult to update); yet the mitigation strategy was often a laundry list of items that didn't logically connect to the risk assessment or development trends.

If the outcome of the first iteration could be summed up succinctly, it would be that it led to a much wider understanding of the term mitigation, mitigation actions, and mitigation planning.

**Second Iteration**

Since we are in the second iteration now, it is difficult to project outcomes and overall success. Over the past few years; however, there have been some changes that should result in a more positive outcome. First, the revised FEMA mitigation planning guidance from July 2008 contained a significant new incorporation – those requirements related to flood mitigation assistance plans. Specifically, all new mitigation plans must contain elements related to NFIP participation, mitigation actions to remain compliant with the NFIP and strategies for repetitive loss properties. Also, in a nod to the limited technology and models available at this time, more detailed vulnerability analyses were not required (which is also expensive). It should also be noted that HAZUS MH-4 was released in fall 2009 which has a dramatically improved flood risk assessment function. Finally, financial resources are available from FEMA to undertake hazard mitigation planning updates through three of its mitigation grant programs. This funding will play a critical role in supporting local hazard mitigation planning for a wider variety of communities, especially given the difficult economic climate.

It is likely that the second iteration will produce more refined and specific, mitigation oriented plans. Communities will have a better understanding of hazard mitigation and may begin to think of ways to incorporate it into other similar mechanisms such as comprehensive planning, land use regulations, capital improvements budgeting, as well as emergency management. The overall quality should improve and the plans should be crafted to correct deficiencies identified in the first iteration plans. However, it is questionable whether more mitigation actions will be undertaken.

**Third Iteration**

Although several years away, it is not too early to boost chances of a successful third iteration by planning now. The focus of the third iteration should be actively managing hazard risk and integration of mitigation planning into other community operations. Since flood is among the most significant hazards facing our communities, mitigation planning is of special importance to floodplain managers. Below is a list of recommendations for changes in preparation for the third iteration:

- Availability of Public Assistance funds for communities should be contingent on having a FEMA approved adopted mitigation plan. This would be consistent with what is already required for states and would emphasize the importance of mitigation planning.
- FEMA approval of local mitigation plans should be contingent on the participating jurisdiction's accomplishment of at least on mitigation action identified in the plan. Current reviews and approval do not require accomplishing mitigation actions.
- A portion of FEMA's mitigation grant programs should be carved out and set aside as a new program focused on mitigation plan action implementation. This could be done on a limited, competitive basis, and the focus of the funds would be to fund projects that are specifically identified in mitigation plans that might not otherwise be funded.
- FEMA's review process should become more refined and focus on items that will produce desired outcomes. For example, the requirement to have a mitigation action for each hazard profiled should be discontinued – especially if it is determined to be a low risk hazard. The cross-walk should have more focus on plan integration with other

planning and land use programs that exist, and should include a greater analysis of a community's capability to do mitigation.

- Mitigation planning "how-to" guidance should be updated and new materials produced. The FEMA 386 series guidance documents should be updated to reflect the state of the art in mitigation planning as well as be refocused on plan updates versus development of original plans. A new "how-to" should be developed to specifically focus on NFIP and floodplain management elements of mitigation plans – how to describe community participation, identify the range of actions related to maintaining NFIP compliance and/or improve floodplain management programs.
- The mitigation planning process should mandate that local floodplain managers, land use planners, and emergency managers participate in the planning process as they have the greatest impact on the implementation of future mitigation actions.
- Continued investments must be made to improve risk assessment methodologies and FEMA should work with other federal agencies that have designed these methodologies. For flood hazard mitigation, easier, more accessible methodologies should be developed for dam failure (perhaps a dam failure module for HAZUS).
- There should be a mechanism in place for the electronic storage of both risk assessments and mitigation plans. With the ever decreasing costs of electronic storage, and the improvement of web based portals to upload and access data, national data storage depots should be ready for importation of mitigation plans and risk assessments.

In sociological terms, it takes many years for a new idea to achieve widespread implementation. It is logical then to assume that mitigation planning will take some time and careful manipulation to reach its full potential. A timeframe of 15 to 30 years is not unreasonable. Initial efforts during the first two iterations have succeeded in transferring knowledge about hazard mitigation and mitigation planning to the public at large. The next iteration must be focused on active management and implementation. For floodplain managers in the United States, mitigation planning is not an option; rather, it should be seen as a vehicle for comprehensive flood loss reduction.

# NATIONAL WILDLIFE FEDERATION: SAFEGUARDING FLOODPLAINS FOR PEOPLE AND NATURE

**Vicki Deisner**
***National Wildlife Federation***

Climate change poses an unprecedented threat to our coastal and riverfront communities, where a large segment of our nation's population resides and a majority or our economic activity occurs. Sea level rise, strengthening of storms and floods, and other impacts of climate change are already being felt and are expected to intensify over the coming decades. When combined with excessive development, these stresses can drive species to extinction and destroy important habitats that protect and enhance our economy and quality of life.

The National Flood Insurance Program (NFIP) is intended to reduce the costs and vulnerabilities to flooding by identifying flood hazards, encouraging and requiring floodplain management and providing flood insurance at reasonable rates within communities that choose to participate in the program. Rather than discouraging development in vital floodplains, the Federal Emergency Management Agency (FEMA), which administers the NFIP, has implemented the NFIP in a manner increases flood risk to communities and is harming the natural resources and functions of floodplains and damaging federally protected wildlife in violation of the Endangered Species Act (ESA). In reforming the floodplain policy, Congress and the President must consider the floodplain management consequences of federal programs outside of FEMA and NFIP, as well as recommitting to a national hazard mitigation policy that emphasizes stronger standards, including rules that place homes and businesses in areas safe from flooding. Keeping development out of dangerous and environmentally sensitive areas presents an effective, economic and yet often overlooked method of reducing flood losses.

The federal government must renew its commitment to reduce flood risk to communities and natural resources. The National Wildlife Federation and its partners will advocate for the following needed changes. A handout about the NFIP and endangered species appears as the last two pages of this paper.

**(1) NFIP community eligibility criteria must reduce flood risk to people and protect and restore natural resources.**

Currently, the community participation eligibility criteria in the NFIP do not require adequate protection or restoration of natural resources and the functions of floodplains that benefit communities and species. This is endangering the public and destroying beneficial natural resources. Eligibility criteria must be enhanced so that participation in the NFIP requires communities to maintain or improve the habitat and flood management values of floodplains.

- Development in floodplains must be restricted or prohibited in high hazard and environmentally sensitive areas unless it is shown to have no adverse effect on natural resources or can be fully and sustainably mitigated.

- Repairs or improvements to existing structures must mitigate for damage to natural resources.
- All mitigation should prefer non-structural means and must account for the impacts of climate change.
- Voluntary buyouts of homes and businesses in high flood risk areas should be promoted with appropriate lands dedicated to open space uses.
- Communities should be required to strengthen land-use and building code standards and employ low-impact development methods to prevent and/or minimize the degradation of floodplain habitat.
- FEMA must bring the NFIP into compliance with the Endangered Species Act and other conservation laws to prevent harm to ESA listed species affected by floodplain development.

**(2) FEMA mapping must use the best available science to accurately reflect risk and place a priority on natural resources protection.**

Mapping determines what areas and properties are subject to NFIP requirements. Currently, many FEMA maps are out-of-date, do not reflect the best available science or future flood risk resulting from land use and climate changes, do not identify important natural resource and habitat areas, and can be manipulated to allow for the removal of important areas from NFIP requirements in a manner that degrades or destroys natural resources. In order to protect floodplains, and minimize future flood events, FEMA must increase the accuracy of their floodplain maps and incorporate the effects of climate change and other future conditions. FEMA is currently engaged in a nationwide effort to improve its flood hazard maps, but much more needs to be done.

- Floodplain maps must reflect the best available science regarding flood risk and natural resource protection by using accurate and current data, including science regarding climate change and other likely future conditions.
- Map revisions must make protection of listed species, habitat and natural resources a priority.
- FEMA's flood maps must show a range of varying high risk areas up to the 500-year flood zone and "residual risk" areas that would be inundated due to levee or dam failure, and require appropriate land use and building codes to reduce risk and require properties in residual risk zones to have flood insurance.
- Map revisions that remove areas from flood insurance requirements due to placement of fill or levee construction must be eliminated.

**(3) Rates must reflect risk and provide incentive for floodplain and natural resource protection.**

Currently, NFIP insurance rates do not reflect actual risk of flood damage and communities are not given adequate incentives to adopt policies that protect floodplains and the natural resources they provide. As a result, federal taxpayers are subsidizing development in dangerous and environmentally sensitive areas. As long as rates are not in line with reality, harmful development will continue. On the incentive side, the community rating system (CRS) should be modified to increase credits for actions beneficial to wildlife and floodplain functions, and decreases credits for actions that are detrimental to wildlife and floodplain functions.

- FEMA must increase NFIP rates to reflect the actual risk (in insurance terms "actuarial risk") of building and occupying flood-prone areas.
- The CRS should be modified to require habitat preservation and restoration, development policies that protect and do not destroy or degrade floodplain functions, and policies that work to eliminate harmful levee construction and filling practices.

- Municipalities which are currently "self-insured" should be required to obtain insurance for their properties in flood-prone areas in order to place the cost of risk on localities for locating development in flood-prone areas.
- There should be no expansion of taxpayer subsidies to insure risks such as wind damage that would encourage coastal and floodplain development in at-risk areas.
- Communities should be required to prohibit all government-subsidized development from the mapped very high hazard areas.

**(4) To protect communities against floods, natural functions should be the priority of all federal agencies, and levees should only be used as a last resort.**

A variety of other federal programs in agencies ranging from the Corps of Engineers to the Department of Housing and Urban Development (HUD) have vast impacts on the manner in which this nation uses and manages areas that are likely to flood. Currently, FEMA and Corps policies promote the construction of levees, which results in destruction of floodplain functions while exposing communities to flood risk. FEMA and the Corps must change their policies to rely first on environmentally and economically sound natural functions to protect communities from floods and only use levees as a last resort. Severe repetitive losses place an enormous burden on taxpayers, communities, and the environment. Repeatedly flooded properties should be removed from the NFIP to get people out of harm's way and reduce flood risk and flood damage.

- FEMA must discourage the construction of new levees to control flooding and remove incentives to communities for constructing new levees.
- FEMA must require areas behind levees and below dams to have mandatory insurance purchase requirements.
- New levees must hew to guidelines which protect natural resources, and existing levees should be maintained to restore and enhance habitat value .
- Projects that reduce flood risk by protecting natural resources should be rewarded with grants and other assistance.
- Voluntary buyouts and other programs should encourage vulnerable development to relocate to safer areas so that aging, high risk or high cost levees can eventually be removed and floodplain areas restored. Any levee upgrades or alterations should protect and restore natural resource values.
- Congress should establish firms rule that no property should be rebuilt more than twice.
- Other federal agencies, such as the Corps' water resources program, should be reformed directly alongside NFIP to promote sound water resources management policies.

**(5) Disaster Relief Programs Must Encourage Floodplain Protection.**

Disaster relief programs currently provide little incentive for communities to protect floodplains as they allow communities to receive assistance to rebuild in flood prone areas when floods strike. Communities must be given reason to discourage development in flood-prone areas and should not operate under the assumption that poor planning decisions will always be bailed out when predictable disasters occur.

- Disaster relief and NFIP must be administered in a coordinated manner so as to reduce flood risk to communities and to protect and restore natural resources.
- FEMA should promote wise floodplain management and greater use of non-structural mitigation techniques, such as voluntary buyouts, building elevations and open space preservation to reduce flooding risks.
- Mitigation strategies, such as individual home retrofitting, would be prudent options to assist low-income communities, as well as means-tested premium payment assistance and grants.

# America's Floodplains: Better Management for a Better Future

## What are Floodplains?


Credit: Don Becker/USGS

Floodplains, the flood-prone bottomlands that cradle rivers and streams, are nature's best defense against floods and provide invaluable functions for wildlife and communities. Undisturbed floodplains — or those that have been restored to a near natural state — provide such benefits as flood and erosion control, groundwater recharge, enhanced farm lands, and recreational opportunities. Development along floodplains puts people and property in harm's way, resulting in more frequent and severe floods, species at risk, and compromised water supplies.

## Why are Floodplains Important?

Floodplains are vital to the safety of our communities and the health of our environment. They provide fish and wildlife habitat, filter water, and provide natural defenses against storms, hurricanes, and floods, which are being exacerbated by global warming. For example, in 1993, a massive flood devastated communities in 9 Midwestern states, topping more than 1,000 levees, displacing thousands of people, and causing more than $30 billion in total damages [1]. Only 15 years later, in 2008, a similar flood hit the Midwest, causing $15 billion in total damages [2]. Scientists predict severe flooding events like these will become more frequent and severe due to climate change and continuing development in watersheds.

## What's Happening to Our Floodplains?

Irresponsible development and climate change are causing us to lose our floodplains at an alarming rate. As our floodplains disappear, so does our protection against flooding, making us more vulnerable to natural disasters. **U.S. average national flood damages have approximately doubled over the 1990s, rising from $7.7 billion annually in the 1990s to $15 billion annually over the past 5 years.** These costs will continue to increase as the changing climate leads to more frequent storms and intense rainfall events and for as long as our land-use decisions and policies encourage development in floodplains.

**The current floodplain management system in the United States is not working.** The federal government has done very little to protect floodplains and what it has done has been ineffective. Not only does the current system fail to discourage people from building and rebuilding in vulnerable locations, it also uses taxpayers' dollars to encourage and enable development that is costing billions of dollars in losses.

**Congress needs to change the way we protect ourselves from future floods.**

## What's Wrong with the National Flood Insurance Program?


Credit: Don Becker/USGS

The National Flood Insurance Program (NFIP), under the Federal Emergency Management Agency (FEMA), was intended to reduce the cost of and our vulnerability to flooding by identifying hazards, encouraging and requiring smart floodplain management, and providing flood insurance at reasonable rates. Instead, it has been administered in a manner that is destroying floodplains and wildlife habitat and placing people in harm's way at taxpayer expense.

As implemented, the NFIP:

- Increases flood risk and harms natural resources by offering discounted insurance for construction in areas vulnerable to flooding and failing to discourage development in high-risk flood-prone locations;
- Funds the reconstruction of properties that are repeatedly being destroyed by flooding, even when relocating or buying out the property would be more cost-effective;
- Fails to adequately inform citizens of flooding risks;
- Runs a mounting debt—the program is currently $19 billion in debt to the U.S. Treasury in large part because it sets insurance rates in some cases far below levels that reflect actual risk; and
- Fails to protect and restore natural and societally beneficial floodplain and ecosystem functions.

## The National Flood Insurance Program Hurts Wildlife

Credit: TurtleDude from Flickr

**The NFIP is leading to the decline of species like salmon, orca whales, and sea turtles and pushing them toward extinction.** The National Wildlife Federation (NWF) has initiated a series of lawsuits under the Endangered Species Act that challenge FEMA's administration of the NFIP because it is allowing building practices in floodplains that are substantially damaging key wetlands and habitat essential to the recovery of species like these.

While there has been some success with these lawsuits and FEMA has begun to address administration of flood insurance in the Florida Keys and Puget Sound, it has thus far refused to reform the way it administers insurance throughout the country. In many instances, high risk building and rebuilding is continuing in natural areas that provide important recreation, fish and Wildlife habitat, and other natural values, leading to increasing damages and disaster costs.

## Tulsa, Oklahoma: Floodplain Management Done Right

Tulsa, Oklahoma, has experienced recurring flooding since the 1970s. Starting in 1977, the city began moving houses out of flood-prone areas. However, after the Memorial Day flood of 1984, which killed or injured over 300 people and caused $184 million in damages, the city instituted a far more comprehensive flood management program which emphasizes the use of non-structural solutions [3].

The city has since relocated over 900 buildings from flood-prone areas, instituted new restrictions on construction in high-risk areas, and incorporated natural functions into its floodplain management approach to protect its citizens from the threat of future floods [4]. FEMA should be directed to substantially improve its standards to reduce subsidies and require stronger floodplain management in flood-prone communities across the nation.

## What Should Congress Do?

Floodplain management in the United States needs to change now. Congress has an extraordinary opportunity to change the way floodplains are managed in the United States with the pending renewal of the NFIP. Our lawmakers must act now to protect our environment and our communities from the increasing threat of climate change.

Congress should:

- Require communities to maintain or improve the habitat and flood management values of floodplains;
- Develop floodplain maps that accurately reflect risk and prioritize natural resource protection;
- Use insurance rates that reflect risk and create incentives for floodplain and natural resource protection instead of construction in flood-prone areas;
- Prioritize natural functions to protect against floods, instead of using levees and other structural solutions, which always leave homes and businesses at risk of catastrophic flooding;
- Encourage floodplain protection in disaster relief programs; and
- Ensure the NFIP is not expanded to cover wind damage.

Credit: Adam Fagen from Flickr

**Through these measures we can better understand the short-term and long-term tradeoffs when it comes to floodplain development; more accurately value floodplains for the benefits they provide in terms of buffering against storms and other adverse events; and develop a forward-thinking vision for the future of floodplain management in the United States.**


Sources:

[1] In normalized 2007 dollars. U.S. Congressional Research Service, Federal Flood Policy Challenges: Lessons from the 2008 Midwest Flood (R40201; Feb. 5, 2009), by Nicole T. Carter.
[2] In normalized 2007 dollars. *Ibid.*
[3] American Rivers, Natural Security: Short Community Case Studies, http://www.americanrivers.org/our-work/global-warming-and-rivers/infrastructure/natural-security-case-studies.html#Tulsa (last accessed: January 10, 2010).
[4] *Ibid.*



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# LEVEE CERTIFICATION: THE PERFECT STORM

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Levees are an important part of the nation's critical infrastructure[1] and are vital to managing flood risks to communities that would not be sustainable without these man-made defenses. Just over four years ago, Hurricane Katrina flooded New Orleans, taking innocent lives, causing huge economic losses, and reminding us of both the importance and the fragility of our levees and flood reduction systems. Underscoring the message from Katrina, the American Society of Civil Engineers (ASCE) gave levees an F in its *2006 California Infrastructure Report Card*[2] and a D- in its *2009 Report Card for America's Infrastructure*[2].

There are more than 100,000 miles of levees in the U.S. This is an approximation because, unfortunately, there is no national inventory of levees. Levees, an estimated 85 percent of which are locally owned and maintained, protect all or portions of U.S. counties in which 43 percent of the nation's population resides. Without an inventory or reliable condition assessments, it is not possible to accurately estimate the cost to repair the nation's levees, although experts put it at more than $100 billion[2]. Unfortunately, the cost to people and the value of property at risk from levee failures are not known. Also unknown are the indirect costs and economic consequences of flooding. We might ask, Does any critical infrastructure system pose so grave and so immediate a risk to public safety, health, and welfare?

The convergence of four factors is causing our levees to face a perfect storm. First, Katrina and flooding in the Midwest have focused the public's attention on flood risk. Second, there is growing recognition that climate change and sea level rise will increase risk. In addition, structural approaches to flood reduction are being questioned, with some asking whether we should instead work to protect and restore the natural and beneficial uses of floodplains in an approach that the Dutch call "make room for the river."

Third, in light of powerful new methods to analyze risk, evaluate alternatives, and communicate results, engineers are reexamining old concepts, such as reliance on the 100-year flood and traditional factors of safety for levee design. Fourth, flood map modernization by the Federal Emergency Management Agency (FEMA) is shining a bright spotlight on levee certification.

The owners of properties protected by levees may opt out of participating in the National Flood Insurance Program (NFIP) if those levees have been accredited by FEMA. FEMA flood maps and the NFIP are currently the de facto means for managing and communicating flood risks throughout much of the U.S. For FEMA to *accredit* a levee, a federal agency (for example, the U.S. Army Corps of Engineers) or a licensed professional engineer must *certify* that the levee complies with all appropriate requirements. Certification is a technical finding that there is reasonable certainty that the levee will contain the base flood. Unfortunately, neither certification

nor accreditation verifies that a *safety standard* has been met, although it is widely and erroneously believed that "if I live behind an accredited [certified] levee, I will be safe from flooding."

A document used by FEMA to prepare NFIP rating maps is not, unfortunately, equivalent to a document prepared by a licensed professional engineer that is based on the standard of care to assess the risk to public safety, health, and welfare posed by flood reduction systems that include levees. Regrettably, levee certification:

1. May lull the public into a false sense of security by leading them to erroneously believe that the levee will not fail during a 100-year flood.
2. Unintentionally place a licensed professional engineer in serious ethical and legal jeopardy by seeming to confirm the safety of a structure that he or she may not have designed.
3. Is contrary to good public policy and to the ASCE Code of Ethics.[3]

This process of accreditation and certification is a poison pill. There are, after all, only two kinds of levees: those that have failed and those that are going to fail[4]. Against this backdrop, juries in the U.S. tend to be sympathetic to victims; i.e., someone will likely pay for damages, regardless of who is really at fault. This is the legal jeopardy in which licensed professional engineers who certify levees that are eventually overtopped or otherwise fail will find themselves. Since most professional liability insurance companies refuse coverage for claims related to certification of any kind, flood victims will have little or no recourse for compensation. In other words, no one wins, despite the best of intentions on the part of the NFIP to manage and communicate risks.

Tragically, the failure to manage and communicate the risks of living with a flawed system contributed to the death and destruction in New Orleans. Here is how one resident described it to me: "Had residents [of New Orleans] been aware of the engineering faults built into the flood protection system [i.e., accredited levees], there might have been many more who might have opted to take personal mitigation measures such as relocation or elevation. Certainly they would have reviewed their flood insurance for adequacy to this heightened risk. . . . Had residents been aware that the flood protection system was a system in name only, they would have taken individual and collective action to remediate or mitigate."[5]

This is a key lesson from New Orleans. To remedy this shortfall in risk management and communication, FEMA should amend 44 C.F.R. 65.10(b) to change the requirement from *certification* to *evaluation*. In addition, FEMA should develop and adopt a hazard ranking system for FEMA flood maps and the NFIP that is based on either:

1. The maximum flood that is likely to be experienced, or
2. A comprehensive plan encompassing community development, land use, building codes, and emergency preparedness and response, as well as a system of indemnification for losses when levees fail.

Communicating flood risk is a difficult task but is made easier and more effective when there is a common understanding of the content and context of available information. We have an

opportunity to avoid this perfect storm; we can make risk information of the type contained in FEMA flood maps and by the NFIP a powerful means to communicate a common understanding of the relative benefits of alternative approaches to manage or reduce flood risk. This will enable people to make better-informed individual decisions, will give public officials a better understanding of risk, and will facilitate collaboration among governmental agencies at all levels. Without a clear understanding of the flood risks associated with critical infrastructure, communities and individuals may fail to place proper emphasis on flood disaster readiness or preemptive disaster response.

## Endnotes

1. ASCE defines *critical infrastructure* as "systems, facilities, and assets so vital that if destroyed or incapacitated would disrupt the security, economy, health, safety, or welfare of the public. Critical infrastructure may cross political boundaries and may be built (such as structures, energy, water, transportation, and communication systems), natural (such as surface or ground water resources), or virtual (such as cyber, electronic data, and information systems)."

2. ASCE, http://www.asce.org/reportcard.

3. The fundamental canon of ASCE's Code of Ethics reads as follows: "Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties."

4. Personal communication, Edward A. Thomas, Esq., Michael Baker Corporation, March 11, 2008.

5. Personal communication, K.C. King, December 11, 2009.

# INTERRELATIONSHIP BETWEEN THE NEW P&G AND A POTENTIAL REVISED EXECUTIVE ORDER ON FLOODPLAIN MANAGEMENT— WHAT WE SEEK TO ACCOMPLISH

**Doug Lamont**
**Office of the Assistant Secretary of the Army, Civil Works**

## Introduction

The Army and the Corps of Engineers have embarked on a mission to completely re-look at how Corps water resources projects are planned. Hurricane Katrina was a powerful wake-up call to everyone that projects must be examined in a systems context and must address the risks and uncertainties that are inherent with storm damage reduction measures. Subsequent storms and floods, and the resultant damages, in the mid-West and Northeast over the past several years provided yet another reminder that we must re-examine the roles of the Federal agencies in flood risk reduction in order to benefit from lessons learned. The reconstitution of the Federal Interagency Floodplain Management Task Force has focused the Federal agencies on floodplain management issues and brought to the forefront, the need to revisit the Federal Executive Order (EO) 11988 on Floodplain Management. These floodplain concerns as well as the risks and uncertainties associated with climate change must be addressed in any consideration of potential changes to the EO on Floodplain Management. They must also be addressed in efforts to update the 1983 Principles and Guidelines for studies of future Federal water resources development projects. A new EO on Floodplain Management and the revised P&G must complement one another.

## A New P&G

In Section 2031 of WRDA 2007, Congress directed the Secretary of the Army to issue revisions to the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (P&G) for application to projects developed by the Corps. The P&G were approved in 1983 well before Corps water resource studies and projects were subsequently cost shared. Recognizing the need to bring the planning guidance into the 21st Century, the need for more open and transparent Government, and a need to ensure uniform water resources development across all Federal agencies, CEQ assumed the lead for the Administration in updating the P&G early last year. CEQ convened an interagency team that revised the Principles and Standards (P&S) portions of the 1983 P&G. CEQ released the proposed draft P&S for public and National Academy of Sciences review last December. In summary, the draft P&S establish the following tenets:

- A clear focus on public safety first and foremost
- Collaborative watershed-based determination of needs and opportunities
- Collaboration among partners, stakeholders, and the Federal Government to leverage authorities and resources to provide sound solutions

- Focus on integrated water resources solutions based on a systems approach to watershed needs
- Total benefits analysis--putting economic and environmental benefits on balance to recommend the best possible projects
- The use of both monetary and non-monetary benefits to justify and select projects having the greatest net benefits
- Open, transparent discussion of, and ability to account for, risks and uncertainties
- Utilize adaptive management principles to take advantage of experience gained as work progresses and to better manage risks and uncertainties

For Flood Risk Management studies, the P&S:

- Encourages avoidance of the unwise use of floodplains with a major emphasis on public safety, the risks and uncertainties of climate change, and ensuring environmental justice
- Requires full consideration of non-structural solutions—if non-structural alternatives are not chosen, the agency head must explicitly address the reasons why
- Increases the emphasis on providing more equitable solutions to flooding problems in low income communities
- Requires decisions to modify water resources and floodplains to be based upon evaluations of the services gained and lost by such an action; and only those actions that provide net benefits shall be recommended for construction.

## A Revised EO on Floodplain Management

What you have seen is **NOT** the Administration's Draft. The Administration has reconstituted the Federal Interagency Floodplain Management Task Force to address the potential development of a new EO. To date, work by the Corps of Engineers, in concert with other Federal and non-Federal agencies, has focused on the following perspective:

- The need to recognize the value of floodplains to the Nation—this aspect ties in with watershed-based systems context and the evaluation of ecological services required in the draft P&S
- The need for a sound basis for Federal agency actions in floodplains—links with watershed systems approach and collaboration in the draft P&S
- Where possible, seek to avoid or minimize Federal agency impacts to floodplains—links with avoiding unwise use in the draft P&S. Key concerns:
    - development behind levees
    - modification of existing flood control projects/facilities
    - sustainable solutions
    - public safety
- Follow the basic tenets and work in concert with P&G concepts to:
    - enable watershed-based problem identification and solutions
    - account for the cumulative effect of agency actions

- protect/enhance wetland functions—including 1st line of defense in coastal hurricane and storm damage reduction

## Adaptation for Climate Change

Both the revised P&G and any future floodplain management initiatives will improve our ability to adaptively manage for future uncertainties. Fundamental to this will be the ability of Federal water resources planning studies and floodplain management initiatives to account for risks and uncertainties throughout the planning, design, construction, and operational phases in the life cycle of projects. The "Procedures" part of the revised P&G will need to deal with and develop appropriate methods and metrics to gauge how we will measure progress and ensure success.

## Summary

Under the draft P&S, proposed projects will be evaluated more holistically – by considering all potential benefits and other impacts, whether monetary or non-monetary. By using a watershed and ecosystem based approach, the formulation and evaluation of alternative solutions will more fully account for both upstream and downstream impacts. Increased collaboration and transparency will further ensure that analyses and recommendations are appropriate, thorough, and reasonable. This is expected to better inform the public and decision makers, including the Congress, and produce plans and projects that are more robust and more responsive to watershed and National needs.

Together, the new P&S in conjunction with either the existing or a revised EO will significantly shift the way we manage and develop our floodplain resources. Water resources plans and projects, especially when they seek to reduce the Nation's vulnerability to floods and storms, will more consistently recognize floodplains as critical components of the watershed – particularly their role in protecting communities from floods and their other ecological services. Decisions to modify water resources and floodplains will be based on more complete evaluations of all the services gained and lost by the proposed actions and only those actions that provide a net benefit among all impacts would be further pursued or recommended for construction. Importantly, for the first time, such evaluations will give full and equal consideration to nonstructural approaches that may solve flooding problems without adversely impacting other floodplain functions. The actual use of each floodplain will remain a local planning and zoning decision, as this guidance only covers the investment of Federal resources.

# PROTECTING AND RESTORING THE NATURAL RESOURCES AND FUNCTIONS OF COASTAL AND RIVERINE FLOODPLAINS WITH EFFECTIVE FLOOD RISK MANAGEMENT

**John McShane**
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The riverine and coastal floodplains of the United States contain a wealth of natural resources and functions that are of immense value to the Nation. These functions and resources, however, have often been degraded or destroyed by human development and "flood control" structures over many years to the extent that their economic and environmental values have been significantly diminished.

Despite the expenditures of billions of federal, state, and local dollars trying to keep floodwaters away from people, mostly with structural measures, flooding remains the greatest threat and most costly natural hazard in the United States. Furthermore, since the economic and environmental values of the natural resources and functions of floodplains have only recently come to be understood and appreciated, greater effort at all levels of government is needed to ensure that the integrity of natural floodplain systems is maintained or restored. The White House is now promoting a more comprehensive, unified approach to floodplain management and two documents presently being updated and revised will have far-reaching impacts on protecting and restoring the natural resources and functions of floodplains while reducing flood risks.

**Federal Interagency Floodplain Management Task Force**

In 1975, the U.S. Water Resources Council established the Federal Interagency Floodplain Management Task Force to prepare reports for the President to transmit to the Congress on actions needed to achieve a unified national program for floodplain management. The Task Force issued its first report in 1976, *A Unified National Program for Floodplain Management,* which set forth a conceptual framework for floodplain management to guide federal, state, and local decision-makers in carrying out their responsibilities for managing flood risks. The Task Force updated the "Unified National Program" document again in 1979, 1986, and 1994, the later documents emphasizing that the dual, co-equal goals of floodplain management are to reduce the loss of life and property caused by floods and to protect and restore the natural resources and functions of floodplains.

The Task Force has recently been re-established after not meeting for over twelve years. The members are presently preparing a work plan that includes updating the 1977 Floodplain Management Executive Order, revising the "Unified National Program" document, and working with the White House to prepare a new "Principles and Guidelines" for water resource projects. When these mutually-supporting documents are promulgated it will be the policy of the United States to prevent or mitigate the loss and degradation of the natural resources and functions of floodplains while reducing flood losses.

**Floodplain Management Executive Order 11988**

With the support and leadership of the White House (CEQ and OMB), an interagency Work Group was convened in 2009 to update the 1977 Floodplain Management Executive Order (EO). The provisions in the this draft EO do not fundamentally change the concepts and requirements that are in the original 1977 version; it does, however, clarify and enhance the language to protect the environment and provides a clear process for agencies to follow when proposing an action in a floodplain.

Updating the 1977 Floodplain Management Executive Order (E.O.) will have a number of environmental benefits. It is now recognized that coastal and riverine floodplains are often the most productive areas within a watershed and protecting a naturally functioning floodplain system, or restoring a floodplain to a nearly natural state will:

- Provide natural vegetative buffers which filter nutrients and sediment from runoff thus improving water quality;
- Increase wetland acreage and functionality;
- Provide numerous habitats for fish and wildlife, maintain biodiversity, etc.;
- Reduce the frequency and duration of low surfaces water flows;
- Protect streambanks and streambeds by moderating the variability of flow volumes and rates;
- Promote groundwater recharge;
- Moderate temperature fluctuations in streams.

In addition, "flood control" structures (levees, stream channelization, etc.) have often had significant adverse impacts on the water quality and ecological integrity of rivers, streams, wetlands, and floodplains. A national policy promoting the goals of floodplain management, in conjunction with a "non-structural" or "green infrastructure" approach to reducing flood losses, will further mitigate adverse environmental impacts and protect critical habitats, especially in estuaries and coastal wetlands. Furthermore, preventing degradation of the existing natural resources and functions of floodplains and restoring lost functions of floodplains will have numerous economic and environmental benefits that will promote and enhance the sustainability of our communities, and nation.

**Principles and Guidelines for Water and Land Related Resources Implementation Studies**

The *Principles and Guidelines for Water and Land Related Resources Implementation Studies* (the "P & G"), last updated in 1983, is the document that water resources agencies use to determine the cost/benefit analysis for all types of water resource projects. One of the long-standing criticisms of this document is that it is to often biased toward structural measures, allowing, and even promoting, projects that have adverse environmental impacts to move forward.

In 2009, an interagency group was formed by the White House to revise the P & G to ensure that water resource projects would be based on sound science, would consider non-monetary benefits,

and would give equal consideration to nonstructural approaches that would solve flooding problems without causing harm to the natural resources and functions of floodplains. The new P & G emphasizes:

- Co-equal goals – water resource planning and development should both protect and restore the environment and improve economic conditions for present and future generations.

- Project benefits – agencies will need to consider monetary and non-monetary benefits in the selection of a project.

- Protecting floodplains – agencies must avoid the unwise use of floodplains, and decisions will be based on the services gained and lost from an action and only those with a net positive benefit would move forward.

In conclusion, these documents will initiate a fundamental shift in how we manage flood risks, protect the natural resources and functions of floodplains, ensure that ecosystem services are valued, and enhance economic development. All of which are mutually compatible and concurrently achievable goals. Finally, if other countries around the world adopted a similar "unified national program" approach for their society it would help to ensure that we will have a planet with sustainable water, and other important resources, through the 21st Century, and beyond.

# RECONSIDERING THE NATIONAL FLOOD INSURANCE PROGRAM— THE BENEFITS OF A MORE RISK-BASED SYSTEM

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*[Disclaimer: The opinions expressed in this paper are solely those of the authors and in no way represent the opinions of the NAIC or its members.]*

Recent symposia sponsored by ASFPM have attempted to identify better ways to measure and manage risks posed by floods and the resultant effect on economic damage, life safety, societal impacts and ecological health. Better assessment and management of flood risks will lead to smarter development in flood-prone areas and more efficient claims settlement.

The current system of insuring flood risks is disjointed and confusing, resulting in contentious claims resolution and inefficient outcomes. Coverage nuances between homeowner policies and flood insurance policies lead to confusion and dissatisfaction from the public. Everyone involved with managing flood risks and floodplain resources desires a better system. This paper provides an overview of current problems and possible alternatives to the current system.

## Deficiencies in the Current Flood Insurance System

The United States Congress created the National Flood Insurance Program (NFIP) in 1968 in an attempt to reduce future flood losses through flood hazard identification, floodplain management and insurance protection. The program allowed property owners in participating communities to purchase flood insurance for their properties in exchange for state and community floodplain management regulations.

The federal government underwrites flood insurance through the NFIP, assuming all liability for the flood insurance coverage, setting rates and coverage limitations and issuing flood insurance maps. Private insurers sell flood insurance and adjust and pay claims through the "Write Your Own" (WYO) program where the insurers issue flood policies in their name and administer the claim but hold no risk. WYO insurers serve only an administrative role and are compensated by the federal government for providing these services but they assume no financial risk in settling claims. This lack of skin in the game causes conflicting motivations when a loss occurs that might be attributed to wind damage or flooding.

This has often led to contentious claim settlements as a private insurer may have to allocate losses between the insurer's own homeowners policy and the NFIP flood policy. The resulting decision is whether the loss should be allocated to a policy on which the insurer would pay or one where the insurer only functions as an administrator.[1] Left in the middle is the policyholder, who only wants a fair settlement regardless of who pays. Recent "wind vs. water" arguments over Hurricane Katrina losses illustrate this point. A more traditional insurance mechanism in

which those settling claims could not push the losses off on a third party, though not perfect, would be less contentious. In such a system, a policyholder at least knows the party with whom to file a grievance if a policy is not properly paid.

Because there is no private entity taking on risk within the NFIP, there is no built-in incentive to assess risk properly. Government assessment of risk becomes a political process where every possible risk becomes insurable at a price acceptable to the public. A 2008 Government Accountability Office (GAO) Report concluded that the NFIP needs to ensure that its rate-setting methods and data used to set rates result in full-risk premiums that accurately reflect the risk of losses from flooding.[2] The GAO report also found that the NFIP attempts to set rates with old data and inaccurate floodplain maps. The program is dependent upon funding to try to fix these deficiencies. The NFIP's failure to set risk-based rates has also led to the program being $19.2 billion in debt.[3]

A critical aspect of insurance is that risk is priced, sending a signal to policyholders. For instance, rates for fire hazards may be higher in wooded areas lacking proper fire protection, leading homeowners to reassess their decision on where to build. Pricing affects individual decision-making and leads to more efficient outcomes for the nation as a whole. Risk-based pricing causes individuals to "pay their own way" in terms of risk. The current system of subsidized risks sends the wrong signals to policyholders, leading to inefficient outcomes. High-risk areas become over developed due to the relatively lower prices.

The resulting subsidized development also harms the ecological health of some areas. For instance, wetlands have been built upon because the true cost of risk has been subsidized. A private system of pricing would reflect the true cost of building and insuring a property, leading to less development on wetland areas. This in turn helps inland development as these wetlands often provide a buffer for storms, causing them to diminish in strength as they move inland.

Though the NFIP was established with noble goals in mind, the result has been an ineffective system that inaccurately assesses flood risks. Currently, individuals desiring complete protection for their property have to purchase at least two policies, one from a private insurer and another that is financially backed by the federal government. Requiring individuals to buy multiple insurance contracts to cover property is not efficient and not publicly desirable. Policyholders want a policy that covers their entire property rather than just certain perils. Such a policy would reduce confusion and allow property owners to get a better handle on the true risks of their property. It would also drastically simplify claim settlement following a loss, regardless of the peril causing the loss.

## Alternative Method

Prior to the 1960s, flood was a commonly insured peril in property insurance contracts offered by private insurers. The floods in the Mississippi River Valley caused the insurance industry to rethink flood peril. They sought a remedy from Congress and got it. Though it was decided in 1968 that flood is an uninsurable risk in the U.S. and demands a federal program, this argument does not hold weight. Many foreign countries consider flood an insurable risk. Flood risks, like other insurable homeowner risks, contain independent exposures, determinable and unintentional losses along with economically viable premiums. Though flood risk does contain the possibility

of catastrophic losses, this situation can be dealt with in a different manner by providing a government backstop for private losses.

A more efficient solution than what currently exists would be to retool the NFIP and move forward with a private primary insurance mechanism to assess and manage risks. Such a system could possibly start with a mandatory all-perils homeowners policy.

An all-perils policy would cover most common risks, including flood, but contain traditional exclusions and be issued by private insurers rather than the federal government. This would help to alleviate the problem of uninsured property owners and would end policyholder uncertainty about what perils are covered and if multiple policies are needed. Policyholders would only have to deal with one insurer and one adjuster in the event of a loss, allowing the claimant to have a single adjuster settling claims without the conflict of deciding to which policy to allocate the loss. Policyholders would better understand this insurance system and subtleties such as whether flooding was caused by wind-driven water, storm surge or rain-induced flooding would be eliminated.

Under such a system, premiums would be risk-based. Property would be developed based upon the true risk. The current NFIP improperly assesses risk in a non-actuarial manner, sending the wrong signal to property owners. This causes unintended consequences such as harm to the environment as subsidized development occurs in areas where it might otherwise not. A private risk-based insurance system sends accurate signals to property owners and makes them pay their true risk. If individuals decide to build in a high-risk area that is likely to flood, they will pay for that risk through the all-perils policy.

Private insurers would also have a greater incentive to ensure that floodplain maps are accurate and up-to-date if the risk they wrote, and thus their profit, were dependent upon the maps. The current system relies upon the NFIP obtaining funding to update data and maps where a private system would give insurers no choice but to accurately maintain maps and assess risk in order to survive in the marketplace.

Because it is not expected that the insurance industry would provide this broad coverage, including flood risk, without adequate financial backstops for the most extreme events, the NFIP could be converted into a reinsurance program that would provide coverage to insurers with the primary insurer assuming at least some of the risk of loss. The assumption of risk would make the insurers more accountable as it would be their surplus at risk with support from the NFIP, rather than ceding 100 percent of the risk to the NFIP. The conversion of the NFIP into a reinsurance mechanism would utilize the federal government in the implementation of a public/private risk pooling mechanism for spreading the timing of catastrophic flood event insured losses.

A limit of liability would provide assurance to the private market that flood insurance could profitably be written with actuarially sound rates. This extra layer of protection is needed in a system in which risk is taken on by private insurers.

A private market also encourages mitigation because such efforts are priced within policies. These incentives, often in the form of premium credits, lead homeowners to take action they might not otherwise take without the extra economic benefit. In addition to premium credits,

property owners should be educated about how specific mitigation efforts can increase property values and decrease insurance premiums. Other mitigation policies that should be considered are low interest loans, grants for mitigation efforts to upgrade existing properties, and the strengthening and enforcing of building codes.

As stated above, many countries see flood insurance as an insurable risk. Most of these countries allow insurers to set aside reserves to pay for catastrophic losses on a tax-deferred basis.[4] This approach has been considered and rejected by the U.S. Congress in the past. Nonetheless, an allowance of a tax-deferred reserve for future catastrophes would be beneficial in working towards achieving a self-sustaining private market.

## Conclusion

The current system of flood insurance in the United States is disjointed, confusing and contentious for policyholders; harmful to the environment; and economically unsustainable. A system that brings private insurers back to the market will provide more efficient outcomes in terms of accurately assessing risk, efficiently settling claims, and properly developing land, all while reducing an enormous burden to the public budget.

This paper does not attempt to address the difficult and lengthy actions that would have to be taken to achieve a more risk-based flood insurance system. But it is safe to say that though getting there will not be easy, it is absolutely necessary from a public policy perspective.

## Endnotes

1. A recent GAO report has found that the federal government did not properly oversee private insurers' handling of billions of dollars worth of NFIP claims from 2005-2007. GAO-10-66, *Improvements Needed in National Flood Insurance Program's Financial Controls and Oversight*, December 2009.

2. GAO 09-20, *Options for Addressing the Financial Impact of Subsidized Premium Rates on the National Flood Insurance Program*, November 2008.

3. GAO-09-420R, *Information on Proposed Changes to the National Flood Insurance Program*, February 2009.

4. GAO-05-199, *Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks*, February 2005.

# THE NFIP OUTSIDE THE BOX

**Michael Buckley**
***Former Acting Assistant Administrator***
***Mitigation Directorate, FEMA***

The National Flood Insurance Program is entering its 42nd year, is burdened with a $17 billion debt, and is facing major reforms by the Congress. The ideas presented here are radical, but should be considered in discussions on any reforms to the National Flood Insurance Act.
One of the biggest challenges in communicating flood risk to the public has been the mind set of whether you are in the Special Flood Hazard Area (SFHA) or out. The general interpretation is if you are "in" there is a risk. If you are "out" then there is no risk. Use of the terms "100-year flood," or the "1% annual chance flood" has done little to dispel the myth, and probably fuels this notion. Much of the disconnect can be attributed to the mandatory purchase requirement. This has also been the source of much political conflict and controversy particular recently due to the reissuance of flood maps, the state of the economy and the associated cost of insurance. FEMA expends considerable resources addressing these issues, such as responding to congressional inquiries and issuing LOMAs and LOMRs, which could be better spent dealing with flood risk reduction, flood safety, and other management issues. It is time to consider abolishing the mandatory purchase requirement, at least as it is currently structured.

Federally-regulated lenders would no longer be required to ensure mortgaged property locate in a SFHA has a flood insurance policy. Such a change would not result in a mass cancelation of policies. Of the 5.6 million policies in force today, 1.6 million have been purchased on a voluntary basis (Zone X). In addition, there are non-federally regulated lenders that as a matter of practice require insurance, which may well be the case because of secondary market transactions. Because of the recent foreclosure trends (as high as 15% in some markets), lenders are more sensitized to risk and can be expected to continue requiring the insurance.

Establish a policy that federally related secondary market instrumentalities (e.g., FreddieMac) cannot purchase a mortgage unless it has flood insurance. THIS REQUIREMENT WOULD APPLY TO ALL MORTGAGES REGARDLESS OF WHERE THE PROPERTY IS LOCATED. This could be phased in and, over time, lenders will adopt the routine practice of requiring flood insurance on all mortgages, just like it is done for fire insurance today. This would shift the decision on whether flood insurance is needed from FEMA to the lender who would make the decision based on sound business practice considerations.

An insurance rating system should be established which accounts for a continuous and full range of risks. No longer are you in or out. The practice of having high rates on one side of the line and low rates on the other side for virtually the same risk will cease. The terms "100-year flood" and "1% annual chance flood" should be stricken as they will not have the distinction that exists today in the insurance rating process. All properties are at risk from flooding, however minimal that may be. Administrative grandfathering of rates should be abolished. Rates will be very inexpensive in low risk locations, perhaps even well below PRP rates, as there will be a much

wider spread of the risk. Right now there is an adverse selection in the voluntary market of PRPs. Because some properties will have a very low risk of flooding, it may be necessary to adjust the definition of "flooding" and to include coverage for some losses not currently covered, such as basements. Premiums will be collected through escrow accounts just like homeowners insurance is handled today.

Once this construct has matured, it might be feasible for the insurance industry to begin taking over the flood insurance business from the federal government. The pool of insureds will be much larger than the 5.6 million policies in effect today. The practice of writing flood insurance will become routine and not the occasional policy that is the norm today. An infrastructure for accurate risk rating will be in place, and it would be easy to add a flood rider to existing homeowner policies. No more complicated federal rules and regulations, and no limits on the amount of coverage available. Perhaps the federal government could serve as a reinsurer, something that the FEMA Administrator has suggested.

The Flood Zone Determination (FZD) industry would shift from basic in/out calls to a service of determining insurance rates and premiums for the insurance industry. The FZD industry is well positioned to make this adjustment and can begin relying on emerging remote sensing technology and data to make informed decisions on specific properties. They have a wealth of information from communities and other sources, that the insurance industry does not have, which can be used in the rating process. New DFIRMs and supporting elevation data models will be readily available to them as well. Elevation certificates would become optional, removing a certain major expense to property owners.

FEMA could enter into agreements with FZD companies similar to the WYO program. This would eliminate the arduous task of insurance agents reading maps and determining rates. The cost of rating that is now passed on to agents in accordance with established fees under the WYO agreements would be shifted to the RYO (Rate Your Own) program with expected savings because of the concentration of the rating process efficiencies. An alternative would be for the FZDs to enter into agreements with WYOs, similar to how they do business with lenders today. Given the increase in policies and the practice of renewing policies annually, the number of rating determinations would likely be greater than the number of in/out determinations experienced by the FZD industry today, generating even more revenue.

FEMA would continue to produce maps (actually data) in a GIS format for use by communities, the FZD industry and others. Because there is no mandatory purchase requirement, political pressures and conflicts will be significantly reduced, if not eliminated, thereby allowing FEMA to focus its resources on risk identification, risk assessment, communication, planning and risk reduction (Risk MAP!). The risk rating data generated by the FZD industry would be extremely useful in flood risk assessment studies. There will be no need for LOMAs or LOMR-Fs! The debate over levees will shift from the cost of insurance to one of safety.

The only exception to the elimination of the direct federal flood insurance purchase requirement would be for Federal disaster assistance. As a condition for FDA, recipients must purchase and maintain flood insurance regardless of the flood risk. Failure to do so would jeopardize eligibility.

Communities will continue to participate in the program and regulate new development according to the level of risk. Minimum standards can remain in place with a continuation of monitoring by FEMA. The cost of insurance will be a driver behind sound building practices. All communities will participate in the Community Rating System, which will provide a key factor in pricing insurance similar to fire today.

# MUDSLIDE INSURANCE UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

**William Cummings**
***Vacation Lane Group***

## ISSUES

Should the Federal Emergency Management Agency (FEMA) continue to offer insurance against the hazard of inundation by "mudslide" without a purchase requirement applying to areas of greatest "mudslide" hazard and completion of a mapping program and imposition of updated mitigation requirements?

If not, should FEMA then recommend to Congress:

1. That the coverage be discontinued, or
2. That the other components be put in place?

## BACKGROUND

The submission of the National Academy of Sciences (NAS) Report of Methodo1ogy for Delineating Mudslide Hazard Areas (1982) highlights the importance of this set of closely related issues. They have resisted resolution for over ten years and are demanding our attention again through the coincidence of several important circumstances. The Presidential declaration of disaster in California last month has reinforced our awareness of the risk to property and human life that mudslides present. The Federal Insurance Administration (FIA.) has published, in the form of proposed regulation, intended revisions of the Standard Flood Insurance Policy (SFIP), including a change in the definition of flood. A Federal District Court in Cleveland, Ohio has recently issued an opinion and order construing the definition of "mudslide" in the SFIP. A bill has been introduced in Congress (HR 5407) to amend the National Flood Insurance Act to include coverage of flood-related landslides.

The 1969 Amendment to the National Flood Insurance Act directed the NFIP to include coverage for "mudslides caused by the accumulation of water on or under the ground." (42 USC SS 4001(f), 4121(b).) The Act directs the Federal Emergency Management Agency (FEMA) to "accelerate the identification of risk zones within flood-prone and mudslide-prone areas" , in order to make known the degree of hazard within each such zone at the earliest possible date." 42 USC ss 4101(b). Over a period of many years, the agency has received repeated Congressional inquiries on progress of this aspect of the NFIP and repeated assurances have been given that the mapping of "mudslide"-prone areas will proceed; but in fact, the agency's efforts have not progressed beyond the point of investigating suitable mapping methodologies.

### The Grand Scheme of the NFIP

The NFIP was designed to be a fiscally sound alternative to a randomly developed pattern of massive disaster relief. The dual objectives of the NFIP are to compensate victims of flood and

eventually to reduce the need for such compensation. The principal advantages of the NFIP over disaster relief are that:

1. The beneficiaries of the program participate in a major way in the sharing or pooling of the risk, through the payment of insurance premiums; and
2. The Federal Government, over time, will be able to reduce the number of structures at risk and the extent of damages to individual structures through the imposition of risk-management requirements in exchange for the insurance benefit.

The design of the NFIP has been articulated with great clarity in the 1966 Report of the Senate Committee Banking and Currency (89th Congress, 2nd Session). Its effectiveness depends upon the interrelationship of three major elements:

1. Delineation of the risk;
2. Mitigation of the risk; and
3. Insurance (with a purchase requirement in high-risk areas).

Delineation of the risk encompasses determining the probability of the occurrence of the hazard, the magnitude of anticipated property damages and the geographic distribution of the peril. It also involves communicating the determinations to the public, by the publication of maps, for example. This first element is obviously important in mitigating against the risk and setting appropriate insurance rates.

Mitigation of the risk is accomplished through dissemination of information about risk-management and the imposition of a requirement on communities (as a condition of eligibility for the insurance feature) of the enactment of adequate risk-management ordinances, including restriction of new construction in areas of known risk.

The insurance element of the program is operated much as insurance is offered through private industry, except that the purchase of f1ood insurance is required in designated floodplains as a condition of eligibility for mortgage loans from federally-controlled lenders and for Federal disaster assistance. This purchase requirement is essential to the operation of the NFIP in order to counter the tendency toward adverse selection, that is, a situation where the insurer assumes only the worst risks. Adverse selection is particularly likely when the premium rates do not fully reflect the true risk and the potential insured is aware of the fact. We know that is the case with respect to mudslides, first of all because we have not systematically assessed the risk, and secondly because the rates are subsidized as a matter of policy in a great number of cases. Without the purchase requirement (which does not apply to "mudslide"-prone areas), there are short- and long-range adverse effects upon the program in areas of appreciable risk, such as unstable hillsides in California. The short-term effect is that other policyholders and the Treasury pay a disproportionate part of the losses in those areas. The long-term effect is that new development is encouraged in those areas.

The fact that this purchase requirement is not available to the private insurance industry is a major reason why the industry does not offer "mudslide" insurance or flood insurance generally. The other principal reason is the lack of an adequate database from which to calculate sound premium rates. The mapping of "mudslide"-prone areas is an important step toward the setting of risk-specific rates. Over a significant period of time, claims data accumulated in the insurance program can enhance the processes of delineating and mitigating the risk.

The 1966 Senate Committee report strongly suggests that all of these steps should be done in conjunction with one another (as a single program) and replicated separately for each category of risk.

**The Horns of a Dilemma**

The 1969 Amendment to the Act presented FIA with the necessity of choosing between two less than satisfactory alternatives. On the one hand it was directed to make the NFIP respond to the hazard of "mudslide" as if it were virtually the same as riverine flooding. On the other hand, a description of "mudslides" was imposed to "which the NFIP, as it was then constituted, could not appropriately be applied."

The 1969 Amendment states specific findings that "mudslides" cause damage and loss similar to those from storms, deluges, overflowing waters and other floods and that the problems and possibilities in protecting the public were similar to those already encountered in the NFIP. (42 USC ss 4001(f).) In addition, the 1969 Amendment noted a Congressional purpose to make insurance against "mudslide" available through methods, procedures and instrumentalities already in use in the NFIP. Ibid. Thus, the Amendment was based on an assumption that "mudslides" were sufficiently like floods to be assimilated easily in the workings of the NFIP.

On the other hand, the terminology by which "mudslides" were described made this virtually impossible to accomplish. The Amendment identified the natural hazard to be addressed as "mudslides caused by the accumulation of water on or under the ground." (42 U.S.C. § 4l2l(b).) However, as NAS has pointed out, the term "mudslides" does not have a generally accepted technical meaning, and that about 90% of all landslides are caused by accumulation of water. The language of the Amendment applies to almost all landslides. Landslides are a distinctly different hazard from flood. The mapping methods, the mitigation measures and the purchase requirement which apply to riverine and coastal flooding cannot readily be made to apply to landslides. The difficulties involved in attempting to map the hazard of "mudslide" reflect the dichotomy inherent in the 1969 Amendment.

The present NAS report is the second submitted to FEMA on this subject. The first one, in 1974, because of the technical questions involved in distinguishing "muds1ides" from other forms of landslides, recommended that the mapping program investigate areas susceptible to landslide without regard to the degree of wet flow likely to be involved. It went on to make specific recommendations for conducting such studies. FEMA has not tested the recommended methods. The second NAS report makes it clear that the formulation of specific mapping methods awaits a decision from FEMA on what is to be mapped. It poses, the question, "what does FEMA mean by 'mudslide'?"

The 1982 NAS report offers material which can be very helpful in making this decision. The report employs certain broad categories which have a sound technical basis but may also be understood by the layman. This is an important consideration because any ambiguity or lack of clarity in an insurance contract works against the insurer. The report refers to the entire range of flood and landslide events as a continuum, which can be divided into two major categories, and four principal subcategories. In the NAS analysis clear water floods and "mud floods" are examples of flooding, and landslides include both "mudslides" and other landslides. The

relationship of these different classifications to each other and their status under the NFIP are shown in the attached figure from the NAB report.

The characteristics which NAS relied upon in identifying and distinguishing each subcategory were: 1) the geomorphic location, 2) the character of the moving material, 3) the mechanisms of transport, and 4) the nature of damages typically caused by the event. "Clear water flood" refers to inundation by clear water, perhaps carrying some sediment, that typically occurs from river overflow. "Mud flood" refers to flood water carrying heavy loads of sediment (as much as 50 percent by volume), including coarse debris, that typically occurs on alluvial fans near mountains and sometimes on floodplains . Both of these phenomena are hydraulic flows and are clearly included under the NFIP flood definition. Current flood mapping, however, does not reflect the risk of such flooding in steep gradient mountain basins and alluvial fans.

The term "mud flow," as used in the NAS report, is a subset of landslides whose main transport mechanism is flow with sufficient viscosity to support large boulders within a mix of smaller-sized particles. The greater viscosity distinguishes "mud flows" from "mud floods." "Mud flows" may be confined in drainage channels or occur unconfined on hill slopes. The NAS report reflects some uncertainty about whether "mud flows" are included in the NFIP definition of flood. "Other landslides" refers to wet or dry material movement by mechanisms other than flow that can occur without heavy rain, snowmelt or flooding, although they are often triggered by such events .

A heavy rainstorm can cause all four of these natural processes. Moreover, landslides can become "mud flows" and "mud floods" can change to clear water floods as rain adds water to the total flow of sediment and debris.

Debris deposits left by these natural processes can be used to determine which process caused the damage be pattern of sorting of particle sizes within a "mud flood" deposit is distinctly different from the pattern within. "mud flow" deposits. Similarly, "mud flow" deposits can be distinguished from other landslides by their deposits.

A moderate amount of technical guidance, based on this classification system should enable an adjuster or other non-scientist to distinguish one type of event from the others by visual inspection of the site.

## ALTERNATIVES

Two alternatives appear available to FEMA for the resolution of the "mudslide" issue: 1) to continue present practice or 2) to take action, as the NAS report recommends, leading to clear decisions as to which phenomena are to be included in the NFIP, which "mudslide" mapping methods are to be used, and how these mapping needs can be met. The NAS report presents a strategy for FEMA action that is sound and reasonable.

### The Present Practice

It would be fair to summarize the established approach to "mudslides" as follows: 1) The peril of "mudslide" has been defined without explicit reference to a scientific classification system, 2) the hazard of "mudslide" has not been mapped or otherwise delineated or communicated to the public, 3) no requirement has been imposed on communities to mitigate the hazard of

"mudslides", 4) the flood insurance purchase requirement does not apply where that hazard is uniquely present, and 5) insurance coverage is provided against "mudslide" at rates which do not reflect a separate assessment of that particular peril. There are short-term advantages to this approach. Perhaps the biggest is the cost savings that are realized by no mapping. NFIP administrative costs for handling the mudslide coverage and litigation costs are minimal.

FEMA can say in all truth that "mudslide." insurance coverage at affordable rates is provided to the public and that claims are paid promptly.

There are several long-term disadvantages to the continuance of present practice. The Congress will continue to complain about inadequate coverage after disasters and to insist that FEMA encourage more coverage and start a mudslide risk mapping program. People at risk will not be informed. The availability of "mudslide" insurance, even if limited, will continue to encourage development in areas of high risk and. public purchase at subsidized rates. Adverse selection should anticipated. As word is spread on the availability of this insurance, the Federal subsidy will continue to increase. The Federal subsidy will exceed any savings realized by not mapping. The uncertainty over scope of coverage will generate more lawsuits against FEMA when claims are denied.. Because of the technical difficulties in distinguishing "mudslide" events from other landslides, FEMA is already providing de facto land use insurance, and c1aims payments are estimated to be on the order of $30,000,000 to $50,000,000 per year.

**The NAS Recommendation**

Under this latter alternative, FEMA would take action to: 1) decide which phenomena are to be covered by flood insurance; 2) develop a mapping method and 3) formulate a strategy and program for mudslide hazard mandatory purchase, rating, delineation, and mitigation. As emphasized by the NAS report, this approach requires interaction between policy officials and technical experts. National policy, technical, social and economic considerations would be clearly spelled out. Once this information is avai1able, an informed policy decision can be made by either the Federal Insurance Administrator and/or the Congress as to whether or how to proceed with "mudslide" insurance coverage. The considerable costs of the program can be compared to its benefits and the extent of Federal involvement determined.

Although each of the decisions made will have significant impacts, the most important is that which determines which of the natural phenomena are to be insured. If the most restrictive is chosen to limit coverage to "mud floods", deviations from the present NFlP approach would be minimal although some costs would be added. If, however, the decision is made to cover part or all of the landslide phenomena, "mud flows" and/or other landslides, a major restructuring of the NFlP would be necessary. To be fiscally responsible and equitable, a new system of actuarial rating would have to be established, landslide risk areas mapped, and hazard mitigation action required of communities. The present NFlP approach to insurance, floodplain management regulations and mapping is not applicable to landslides and a complex new system would have to be created. Significant costs and time to the Federal Government would be entailed in accomplishing the hazard determination and mitigation. The decision to implement any form of landslide insurance, including insurance against "mud flow," through the NFIP is an important one and requires careful deliberation.

The advantages of FEMA taking the NAS recommended approach are considerable. The scope of protection under the flood insurance policy would be clarified for the Congress and public. If

the full three-pronged approach is taken, hazard evaluation, actuarial1y sound insurance rating, and hazard mitigation, the present unwarranted costs against the NFIP from mudslide claims would be reduced, the inequity of the present rates eliminated and those persons at risk would be informed. Importantly, the insurance principle that each hazard covered must bear its share of the cost would be honored. The victims of this hazard would be compensated and the exposure of the public to risk reduced.

There are disadvantages to this course of action as well. Attention will be focused on the mudslide insurance issue. We may be held accountable by the Congress for not responding to their directives to accelerate mapping of mudslide areas. A significant commitment of FEMA staff time and dollars will have to be made to see the approach to obtain the information necessary for the policy decision.

## CONCLUSIONS AND RECOMMENDATION

There is no fiscally sound way to offer "mudslide" coverage without mapping mitigation efforts and a purchase requirement applying specifically to areas identified as having significant mudslide hazard. In a very real sense, insuring against this hazard without utilizing, these other components is worse than providing disaster relief as the need arises. First, we have very little discretion in paying for damage; the insured has a contractual right to be indemnified. But more importantly, the Government and policyholders in “muds1ide”-free areas assume a disproportionate risk because the premium rates do not reflect a separate assessment of the hazard.

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The following is recommended:

1. That the Federal Insurance Administrator, in consultation with technical experts and with the assistance of the General Counsel and the Associate Director for State &. Local Programs and Support, make a preliminary determination as to the range of physical phenomena which ought to be included, within the term "mudslide;"
2. that the Associate Director for State & Local Programs and Support, with the assistance of the Administrator and the General Counsel, estimate the time, cost and level of effort necessary to complete an appropriate mapping program and promulgation of updated mitigation measures; and
3. That FEMA then propose to Congress the alternatives of either discontinuing the coverage or authorizing and appropriating adequate funds for its continuance.

# STRONG COLLABORATION— THE KEY TO FLOOD RISK MANAGEMENT

**Steven Stockton**
***Director of Civil Works, U.S. Army Corps of Engineers***

In managing and hopefully reducing the risks associated with flooding, the strength of the partnerships between the U.S. Army Corps of Engineers, the states, tribes and localities, other federal agencies, regional and non-government organizations, and affected citizens is even more important than the strength of the dams, levees, or other structures.

The Corps of Engineers shares responsibility for risk management with state and local governments and individuals to operate on a system-wide basis to fully assess flood risks and their consequences, communicate that risk to people, and then manage the risk through projects and programs. Corps projects, however, are just one element of an integrated flood risk management system. Careful city planning, zoning, appropriate building codes, and insurance are just a few other elements that must also come into play; and Corps projects must work in tandem with these other elements in order to reduce risk.

Recognizing that each state or region will have unique needs based on its geography, history, climate, and water availability, the Corps of Engineers has undertaken an initiative, formally called "Building Strong Collaborative Relationships for a Sustainable Water Resources Future," to look at flood risk management, and water resources in general, from the states' point of view and work with participants to develop a national water vision and strategy and a federal toolbox to help states meet their water resources goals.

The Corps also conducted an assessment to review the major water management activities and programs of federal agencies. Federal agencies can offer planning, data collection and management, modeling, project development, operation and maintenance, funding grants, technical assistance, water education, mitigation, research and development, and demonstration projects. Federal agencies are also heavily invested in natural hazards management, climate change, and navigation, hydropower, and recreation functions.

From this process arose a set of eight overarching themes with recommendations to guide the nation's water resources planning and management:

**1. Integrated Water Resource Management (IWRM):** Make IWRM more understandable and a preferred way to plan and manage public water and related land resources as a system.

**2. Future National Water Resources Direction:** Foster continued dialogue about a national (not federal) water vision and create support for drafting a national and/or regional vision(s), and supporting policies and strategies.

**3. Governance and Management:** Strive to reshape organizational structures and means to improve water resources management, decision making, and evaluation in ways that build the public will to act for integrated water resources planning and management.

**4. Collaboration:** Promote opportunities and mechanisms for collaborative water resources planning and management.

**5. Water Resources Investment Strategies:** Promote innovative and sustainable financing mechanisms for water resources solutions, including water infrastructure, at federal and state levels.

**6. Managing Extreme Events:** Increase the ability to anticipate and manage natural and human-made disasters and climate change impacts.

**7. Technology Transfer and Knowledge Capacity Building:** Base water resources plans and decisions on good science and technology sharing, and increase scientific and management knowledge and capability at all levels of government.

**8. Enhanced Water Resources Leadership and Education:** Enhance the ability of public officials at all levels to understand and communicate priorities for water resources investments, raise awareness, and build stewardship for responsible water management.

"We believe there are areas where we can join together to provide support across our federal water resources family to support state and regional water planning," said Major General "Bo" Temple, Deputy Commanding General of the U.S. Army Corps of Engineers.

In flood risk management, and water resources policy in general, we seek a holistic approach, shifting our focus from individual and sometimes isolated projects to interdependent systems and from immediate solutions to solutions that consider the entire life-cycle of projects. Such a focus maximizes both economic development and environmental quality, while ensuring public safety without compromising vital ecosystems.

In making decisions for any water resource project, but especially those involving flood risk management where risk of life is involved, we also emphasize risk-based management. We ask four basic questions: What will be the effect on public safety over the life of the project? What is the worst-case scenario? What is the likelihood of its occurring? What would be the consequences if it were to occur?

Both the holistic approach and risk-based management recognize that storm and flood risks change over time as a result of changing weather patterns, land use patterns and the performance of storm or flood protection projects. Over the course of a project's life, conditions such as sea level rise, climate change impacts, rainfall intensity, or land use may differ from those anticipated during pre-project planning. So we need to consider the life cycle performance of our projects within a systems context, and changes that may take place in the areas they were designed to protect.

Resiliency and redundancy are critical, as are adaptive designs to accommodate changed conditions – expected and unexpected – especially those that may be associated with climate change.

Finally, the public needs to understand that there will always be some residual risk in our projects. There's no such thing as being entirely "risk free." Our goal, rather, is to achieve a mutually agreeable level of residual risk. Even after you combine structural, non-structural, zoning, building codes and perhaps avoidance, there's still some residual risk in any flood plain.

This message is not well understood. Some people still believe that Corps projects will negate the need for the other systems. Our goal, however, is for citizens to be so well informed that they can assume responsibility for their own flood risk decisions. The projects we are building will be your projects to live with, operate and maintain, so you deserve a say in them from the outset.

I believe that we can gain more and better solutions for America's cities and states if we work together to define problems and to seek worthy collaborative solutions. We have to work with others in order to leverage the talent and resources that exist. We want to be facilitators in offering a streamlined federal toolbox of support to state and regional entities to enhance the ease and quality of how they plan and manage their water resources and their visions and goals are achieved.